Bulletin of the Atomic Scientists

THE MAGAZINE OF SCIENCE AND PUBLIC AFFAIRS

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NEW HOPE FOR DISARMAMENT

LOUIS SOHN Variations on a Theme

IGOR GLAGOLEV Is Disarmament Practical?

HANS BETHE Disarmament and Strategy

ROGER FISHER Responding to Violations

"Imagine men in a subterranean cave," said Socrates " . . . there from childhood, their legs and necks enchained so that they sit staring before them, powerless to turn their heads. Above and behind them faroff burns a fire, and between the fire and prisoners is a highroad along which, behold! a barrier is built—like the screens set up by puppeteers over which they perform their wonders."

"I see," Glaucon said.

"See too, behind the barrier men carrying all sorts of paraphernalia overtopping it, mannequins and other figures, stone and wood and various productions. Like as not some of the carriers are speaking, others are silent."

"A weird image," said Glaucon, "and weird prisoners!"

"They are like us," the older man replied. "Would you surmise they see anything of another or themselves but the shadows projected by light on the opposite cavern wall . . . You agree that they would believe the shadows of these contrivances the sole truth?"

"Necessarily," he said.

"Then let us suppose one released and compelled suddenly to stand erect and crane his neck and look up and walk toward the light . . . if someone were to force him up the steep and rugged ascent and not let go until he had been dragged out into the sunlight, that would be a vexed and painful journey . . . Yes, and I guess it would take some practice, if he was to see what was there . . .

"And then again if this man made the descent to resume his former place, wouldn't his eyes be clouded, for suddenly having come from the sun? And if he again had to strive with the prisoners there in that old contest of distinguishing between shadows, with his sight confused and his eyes unsteady—and it would take not a little time to adjust—he would seem absurd. They would say, granted he made the trip above, that he had come back with ruined sight, and going up was not even worth the try . . .

"But a man of sense might recall that eyes may be troubled in two ways and for two reasons: by a change from light to darkness, or one from darkness to light."

—from Plato, The Republic

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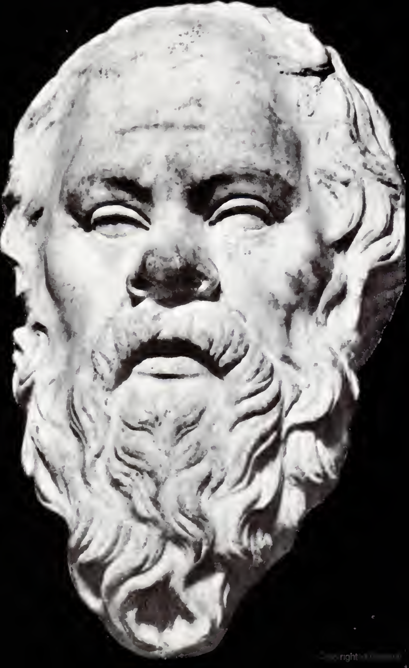
"I know that I do not know"

Socrates, son of Sophroniscus, born 469 B.C., an Athenian. Early career as a sculptor, then in physics where he attained considerable distinction under Archelaus. Noted for gallantry in the Peloponnesian War. Sentenced to death by a popular jury in 399 B.C. for the challenges his philosophical teaching leveled against current religious and political views. Socrates wrote nothing himself; his thought is preserved in the works of his students, Plato and Xenophon.



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Bulletin of the Atomic Scientists

THE MAGAZINE OF SCIENCE AND PUBLIC AFFAIRS

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This One
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A Time for Open Minds

EUGENE RABINOWITCH

That the world faces a dead end, some people know and many more dimly realize. History has been a sequence of power conflicts and wars were their usual climax. Now science has made war too destructive to serve as ultimate arbiter of power conflicts and has thus made the continuation of power politics not only risky but nearly impossible. It has converted threats of war, the traditional weapons of diplomacy, to nightmarish bluffs which to be effective must be believed and yet cannot be rationally believed.

A frantic effort is being made in America by those who want to convince themselves—and persuade others—that this is not so, that traditions of power politics need not be broken, that preparing for war—and winning it if need be—still is the proper thing for a great nation to do. It is argued that even now, an allout war with the Soviet Union would leave enough Americans alive to rebuild the country and to restore both its might on the international scale and its freedoms at home; that extensive shelter construction would increase this capacity manyfold; that anti-missile missiles might permit the defense to catch up with the offense, as it did in the past; that all we need to win the cold war is to keep up the traditional spirit of our people, our martial self-reliance and patriotic dedication—attitudes that built and maintained the strength of this and other great nations in the past.

Yet attempts to deny a radical difference between the past and the present are self-deceptive. Total destruction of life on a continent may be beyond our capacity, but it is within the grasp of a nation dedicated to the continuation of the arms race. Total destruction of all higher life on earth may be merely science fiction today, but is bound to become a practical possibility within a few years if the arms race is continued unchecked. The great irreversible quantum jump, from the world in which wars were rational to a world in which war threatens the suicide of mankind, was made years ago when the discovery of nuclear fission increased man's destructive capacity a millionfold and the discovery of nuclear fusion increased it by another factor of a thousand or more. Attempts to use short range technical arguments to prevent mankind from visualizing its new status, to concentrate popular attention on shelters or on new defensive or offensive weapons emphasizing the political interests at stake in our conflict with the USSR and the improbability of their peaceful resolution, are counsels of dangerous blindness. Our generation has met with destiny; we cannot avoid this challenge or bequeath it to our descendants.

The difficulty of meeting this challenge is often underestimated by believers in traditional liberal concepts. The solution is not simply for our nation to spend less money on armaments, build no shelters and be less intransigent in negotiations with the Soviet Union. Many American liberals are as blind to the novelty of the present situation as are militarists and imperialists. As late as twenty years ago, when wars were rational, it was within the power of a nation to choose a more peaceful or a more warlike policy; certain political elements were militaristic, and their propensity for war could be balanced by the influence of a less warlike opposition. That is a matter of the past. Every responsible political faction, even that of the extreme right, now fears nuclear war; everybody, even the military, wants peace.

For the President to be reminded by telegrams, letters, or pickets in front of the White House that he should work for peace, must be a bitter experience. He wants peace as much as those who bombard him with reminders—even if he does not share the conviction that abandoning nuclear tests, shelter construction, and first-strike weapons is the way to peace. But he is carried forward by the stream of history which he cannot change simply by following the advice of his liberal pacifist critics. What is needed is a radical break with the whole tradition of national statesmanship—that of Franklin as well as Teddy Roosevelt. Nations must reevaluate the ideals to which their national life (and that of other peoples) has been dedicated in the past—the concepts of sovereign nations, national power and grandeur, national security and economic interest; they must dedicate themselves to the pursuit of the viability of mankind as a whole, to its survival and progress.

Our future policies should be decided upon from this point of view. The question, "Is it in the interest of the United States?" or "Is it in the interest of the free world?" must be subordinated to the consideration, "Is it good for mankind?" Our interests and our economic well-being are important to us and we will always pursue them, but just as every citizen in a state is limited in the pursuit of his own interest by the superior interest of the community, so the interest of every nation must now be subordinated to the primacy of the interests of mankind as a whole. Of course, we consider—and justly so—that the American society and the American way of life include certain ideals which have universal validity, and that in defending them we are acting not just in our own interests but on behalf of all mankind. We believe that the concepts of individual freedom, of the rights of man, of fair laws fairly protecting everyone, are universal; but we must cast a critical view on what is truly absolute and universal and what is temporary and accidental in the application of these principles in our society. We must realize that our society, while based on these ideals, does not incorporate them in their only possible or most perfect form. Our multi-party democracy has been and still is an effective system to maintain political and individual freedoms, but this does not prove that it is also the best one to meet all new challenges with which the scientific age confronts nations everywhere.

Our economic system was spectacularly successful in the past age. Competition has been a force for progress and has created in America (and a few other countries) the greatest and most widespread prosperity history has known. But is it also the best under all present and future conditions? Because of scientific and technological progress, the scale of economic enterprise grows and the capital required for new ventures increases in many areas so much that true competition becomes practically impossible. When we wanted to build an atomic bomb, we resorted to government responsibility and leadership. Attempts to preserve the fiction of private enterprise and competition in the development of space vehicles have not given this enterprise its maximum possible speed and effectiveness. Manufacture of weapons or space vehicles by private concerns on the "cost plus" basis does not have private enterprise's fundamental virtue of accepting risk and facing competition. It creates powerful groups—industrialists, scientists, workmen—with vested interests in indefinite continuation of the arms race. Today even the "merchants of death" do not want war (which would destroy them together with everyone else) but they do want cost plus contracts to go on justifying the arms race in their own and other peoples eyes as the best guarantee of peace.

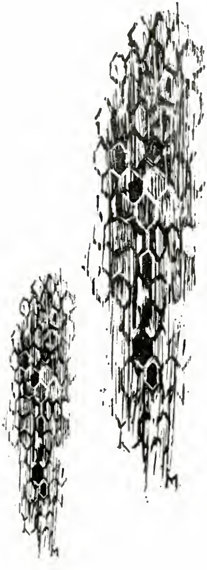
We should not hesitate to ask ourselves whether certain major forms of industrial enterprise can thrive best and contribute most to the interest of the nation as a whole when they are controlled and directed by the representatives of the people and not by private interests. We do not hesitate to admit that rural co-operation and some government regulation have proved to be a better system for the development of agricultural enterprise than unrestricted competition between individual farmers. We must stop unthinkingly identifying the advantages of our economic system with the moral values of individual freedom and of a free society under the law. Under different conditions other systems can be made to serve the same ideals here and elsewhere; they must be judged by their performance and not rejected in advance as evil.

Of course, the views of many other nations—in particular those of the USSR—are even more in need of thorough and unprejudiced reevaluation than those of our society. The Soviet society attributes permanent and absolute value to things which may be good under certain conditions but do not apply to others. The Soviets are in need of evolution toward greater tolerance and broadmindedness much more than we are. They must recognize that private enterprise has proved highly effective in many areas and is far from being a dying system; that in the field of exchange of goods it obviously is more effective than centralized government enterprise; that in agriculture forty years of experience have failed to prove that socialization and bureaucratic direction can even match, not to mention exceed, the achievement of the more flexible and autonomous forms of western agriculture; that individual and political freedom as practiced in the West is not merely a fiction for the benefit of a few; that living under the law has advantages compared to living under a dictatorship, even one that has repudiated its past excesses and the "cult of the individual."

I do not say that we or the Russians should abandon the belief in the principles to which our societies are dedicated, be it personal freedom and political liberty, or economic justice through substitution of central planning for private enterprise. Both societies can hold firm to their belief in the ultimate triumph of their principles in the world, but what is needed is greater mutual tolerance and openmindedness. If the world is to remain divided into two camps, each smug in its feeling of absolute righteousness, the fate of mankind will be self-destruction. The alternative is not simply coexistence, but common existence. In addition to a common desire to avoid war, humanity has many other common tasks and aims—the health of all men, the progress of man's understanding, and the mastery of nature. When scientists work—directly or indirectly—for improved health or increased productivity of man anywhere in the world, they are working not only for their own people, but for all men on earth; when they uncover new facts about the world, they do it for the benefit of future generations of all nations. Unless this consciousness of the essential unity of mankind and of science as its common servant can take root and grow in all countries, the traditional division of humanity into self-centered societies will force science to become the executioner of mankind.

Zonal Disarmament and Inspection: Variations on a Theme

LOUIS B. SOHN



In the following articles by Louis Sohn, Hans Bethe and Roger Fisher of the United States and Igor Glagolev of the Soviet Union the Bulletin *returns to the subject of disarmament with which it has so often dealt in the past. Widespread skepticism exists today about the official disarmament negotiations. The belief that these negotiations are hopeless is reinforced by the cynical observation that whenever one side agrees to the proposals of the other, this proposal is promptly repudiated. This was done once by the West in the London disarmament conference in 1957 and is being done by the East in Geneva where the Soviet Union refuses even to reconsider the test ban control sys- which it not only agreed to three years ago, but insisted upon a year later when the control system was questioned by the United States because of the newly raised possibility of undetectable underground explosions. It seems as if the technical matters over which the wrangling goes on at diplomatic conferences are merely pretexts for avoiding agreement without repudiating the common commitment to the secession of tests and general disarmament.*

However, men of goodwill, and particularly scientists with first hand knowledge of the nature of modern weapons and the danger of an unrestrained arms race, cannot cease to seek a way out of the deadlock. It appears likely that both sides are generally eager for disarmament, because they realize the dangers of a war to their own societies and because they are (and this applies particularly to the Soviet Union) badly in need of the manpower and funds consumed by the arms race and that only distrust of the other side's intentions—stands in the way of progress. The search for mechanisms of disarmament and methods of control which could overcome this mutual distrust cannot be abandoned. The Ninth International Conference on Science and World Affairs held in Cambridge, England, August 25–30, by prominent scientists, including scientific advisors to governments from both East and West, has been devoted to this search. It is the expression of a hope which will not die. E.R.

During 1961 and 1962, the United States and the Soviet Union have reached agreement on the basic principles and the scope of "general and complete disarmament in a peaceful world." The United States, in particular, accepted the idea that disarmament to be effective must be general and complete and that the remaining national forces must be limited to those "necessary to maintain internal order and protect the personal security of citizens." At the same time, the Soviet Union agreed that disarmament must be "accompanied by the establishment of reliable procedures for the peaceful settlement of disputes and effective arrangements for the maintenance of peace," and that such arrangements "should ensure that the United Nations can effectively deter or suppress any threat or use of arms in violation of the purposes and principles of the United Nations."

Despite this agreement, little progress was made in the spring of 1962 on an actual text of a disarmament treaty. This was due principally to a great gulf between the major powers with respect to the timing and phasing of the disarmament process. The main arguments relate to the depth of the arms reductions in the early stages and to the breadth of inspection and verification in those stages. The Soviet Union agrees that when all nations are disarmed, international inspectors would "have the right of access at any time to any point within the territory of each State," but would strictly limit the amount of inspection in the earlier stages. At the same time, the Soviet Union would like to abolish all means of delivering nuclear weapons in the first stage and all nuclear weapons in the second stage. On the other hand, the United States insists that weapons can be abolished completely only at the end of the last stage and that verification arrangements must be "related to the amount of disarmament being undertaken and to the degree of risk to the Parties to the Treaty of possible violations." As long as inspection is limited, disarmament must also be limited. If the Soviet Union continues to insist that all nations relinquish in the first stage the weapons on which they rely to deter potential aggression, it must accept an amount of inspection which would give adequate assurance to other nations that it has not hidden a decisive quantity of such weapons which would give it the mastery of the world. Conversely, if the Soviet Union is able to accept only a limited amount of inspection in the first stage, it should not complain that other nations dare to risk in that stage only small cuts in their military strength. Over the last few years, the Western powers have made important concessions on the extent of inspection to be required in the early stages; the Soviet Union has not yet shown any willingness to contribute to a solution of this issue. The Western powers have, at the same time, considerably increased the amount of disarmament to be accomplished in those stages; the USSR has not shifted in its three-year-old proposals.

The most important Western concession in the current negotiations is based on the concept of progressive zonal inspection, which would guarantee to the Soviet Union that large parts of its territory would be secure from inspection in the early stages. It is an important departure from the previous position that no disarmament should take place until a complete check has been made of an initial inventory, presented by the parties to the disarmament treaty. If proper safeguards are developed, a check of a portion of the inventory in a selected part of a nation's territory might be sufficient to guarantee the accuracy of that inventory. The risk that the selected part of the territory does not provide a fair sample is minor as long as the arms cuts are not deep; with increase in disarmament would come increase in the territory covered by inspection and a concomitant improvement in the accuracy of the sampling process.

This concept of territorial sampling or, more accurately, of progressive zonal inspection evolved in private writings over the 1959–1962 period, and there are many possible variations, each of which has some desirable and some undesirable features. Before presenting the current official proposals, it might be desirable to analyze first some of the available alternatives.

The various proposals for progression from one part of the territory into another may be put in three categories—systematic, selective, or random.

One systematic proposal envisages progression, zone by zone, from one boundary to another, arranged in such a manner that a widening zone of disarmament and inspection would be established between the contending blocs of nations. It would lead thus to a relaxation of tensions and would remove some of the dangers of accidental war which are inherent in close proximity of inimical forces. Taking a leaf from the Eden, Rapacki, and Kennan plans, this proposal would consider the thinning out of forces and the introduction of an inspection system starting with the East-West boundary in Germany and progressing systematically toward the Urals in the east and toward the Atlantic coast in the west. Simultaneously, a similar process might be started in Asia and North America, the zones progressing from the Pacific toward the Atlantic in North America and toward the Urals in Siberia. In China this method might be applied from north to south, in India and Pakistan away from their common borders, and analogously in other countries and continents. Giving this method a global scope, the charges of discrimination leveled against the earlier plans for disengagement would thus be avoided.

Another systematic proposal would avoid the border zones on the ground that nations might prefer to retain forces in and keep foreign inspectors out of the areas in which there is the greatest danger of an enemy attack. While this reasoning might be obsolete in an era of intercontinental missiles, old military patterns do not fade easily and it might be easier to persuade the military planners that disarmament and international inspection should be started away from national frontiers. Each nation might be permitted to choose the area which it considers the least sensitive from the military point of view, in central Siberia or the central states of the United States, and start the disarmament and inspection process there.

It is implied in the systematic approach that the element of surprise in the inspection process would be minimal and that the check it provides of initial inventory would not be reliable as each country might provide correct information only about the first zones to be inspected and might still furiously build its armaments and hide its undeclared weapons in the areas which would become subject to inspection only at the end of the disarmament process. Consequently, this approach might be feasible only in a framework of very limited disarmament, mostly confined to demilitarization, total or partial, of a few dangerous or insignificant regions. Its main advantage would seem to be that a nation would have time to clean up a region before the inspectors get there and would, therefore, not lose any important military secrets. On the other hand, a nation might not have to take its arms cut entirely in the region to be inspected; if it prefers to keep some arms there, it could destroy an equivalent amount elsewhere and prove that fact to the inspectors.

• *SELECTIVE INSPECTION*

Most proposals on progressive zonal disarmament and inspection, however, do not follow the systematic approach; instead they are based on the selective approach. The country to be inspected is permitted to divide the territory into an agreed number of zones, e.g., ten, and the inspectorate chooses one of the zones for disarmament or inspection or both, depending on the variant of this proposal. One of the suggestions would still avoid the need for an inventory and would emphasize the demilitarization aspect of this approach rather than the verification angle. It would rely on the fact that a nation would not know which zone would be chosen and would, therefore, divide its military strength in as even a fashion as possible in order not to lose too much if one zone rather than another should be chosen. According to this suggestion, once a zone is selected international inspectors would seal off its frontiers in order to ensure that no weapons are removed from it. The inspected country would then proceed to demilitarize the zone and only after this process has been finished would the inspectors enter the zone. They would merely check that all weapons have been destroyed and that there are no longer any factories producing weapons in that zone. Having ascertained these facts, they would proceed to another zone.

The more popular variant of the selective method is the one represented in the official United States proposals of April 18, 1962. It must be noted that this method is presented there only as an example of an arrangement relating the extent of inspection to the extent of disarmament, and that the United States has expressed willingness to participate in a study group which would further explore the potentialities of this approach. In any case, the United States considers that progressive zonal inspection of the selective type meets the Soviet requirement that inspection develop progressively with disarmament. The initial Soviet reaction was not encouraging and it would seem that there are some misunderstandings about several important features of the American proposal. It seems desirable, therefore, to explain this proposal in more detail, keeping in mind that these explanations are based merely on this author's understanding of the way in which this proposal might be applied in practice and do not necessarily represent the views of any official agency of the United States government.

In the first place one has to remember that the progressive zonal inspection is only one of three methods of verification envisaged by the United States proposals. The Soviet Union seems to have accepted the two other methods without any difficulty, i.e., the verification of the actual destruction of weapons and of the cessation or limitation of production of weapons in declared facilities. The zonal method applies only to the controversial question of verifying that agreed levels of armaments are not being exceeded and that production is not being conducted in undeclared facilities.

Let us assume, for instance, that the first step of the disarmament process would involve a ten per cent reduction in all major armaments of each participating nation and a strict limitation on the production of new armaments. In such a case, to simplify matters, each participating nation would divide its territory into ten zones, would submit to the international disarmament organization a declaration stating the total level of all major armaments in each zone, and would give the location of the facilities for the production of armaments. The international disarmament organization would immediately check whether these production facilities have ceased to produce further armaments or limited their production to the amount permitted by the disarmament treaty; if necessary, resident inspectors would keep constant watch on such facilities. To permit this, the international disarmament organization must be given the exact location of such facilities. On the other hand, no information would need to be given as to the location of armed forces or armaments within any zone and the zones would be large enough to avoid pinpointing any important military secrets. In addition, each nation would itself determine the boundaries of each zone and would probably do it in such a fashion that such secrets would be evenly divided among the zones. Other nations would not be able to acquire any special advantage by selecting one zone rather than another.

Once a general inventory has been received, the international disarmament organization would itself either select a zone in each participating nation or authorize various groups of states to make reciprocal selections. Upon selection of a zone, the inspected nation would present a more detailed inventory of its military assets in the zone, this time including data about their location. Arrangements would be made to ensure that objects of verification would not be moved from or to the inspected zone, especially during the crucial period between the moment of selection of a zone and the moment of sealing the boundary of the zone by the inspectors. Various suggestions have been made to cope with this problem. For instance, inspection groups might be stationed in all major airports and after the selection of a zone those situated within it would spread immediately toward the zonal boundaries by fast planes, helicopters, and parachuting. Additional inspection groups might be stationed in major transportation centers on railroads, highways, and rivers crossing zonal boundaries, and those in the selected zone would quickly check the traffic going toward the boundaries of the zone. If further safeguards are required, the inspection groups located in neighboring zones might be given restricted authority to check on the content of railroad cars, road vehicles, and river vessels coming from the selected zone. These groups might be permitted to proceed along the transportation lines leading from their location toward the boundaries of the selected zone and to inspect everything on the way. This type of inspection would, of course, be strictly temporary and would expire as soon as the boundaries of the selected zone have been completely sealed. None of the inspectors stationed in centers away from the selected zone would actually perform any inspection functions at their location but all would move quickly either to the selected zone or out of the country. The inspected country, if it should so desire, might be allowed to impose restrictions on all inspectors prior to the moment of selection. Those not actually entitled to perform inspection functions in or near the selected zone could also be restricted after the moment of selection but only until they have left the country or joined the group in the selected zone. Such restrictions might require the inspectors to use specified transportation lines and to stay in designated areas.

If the arrangements outlined here are considered too onerous or too complicated, other arrangements might be agreed upon, especially if the number of zones to be selected should be sufficiently increased to permit quicker sealing of the borders of a much smaller zone.

Within the selected zone the inspectors would be given free access to all legitimate objects of inspection. These would include not only all declared arms depots, army camps, and arms factories but also all places in which arms might be hidden or production activities might be conducted. Aerial inspection would also be permitted, though proper safeguards would have to be devised against aerial photography of areas beyond the boundaries of the inspected zone.

While in the example given, each ten per cent reduction in armaments would be accompanied by the inspection of one zone out of ten, other combinations are, of course, possible. For instance, twenty zones might be established, the inspection of one of which would accompany the early ten per cent cuts in armaments, while in later stages first two and then three zones would be inspected during a ten per cent cut.

A zone once chosen would remain subject to inspection in the succeeding periods, but such later inspections need not be as extensive as the original one. The area subject to inspection would thus increase with each disarmament step and by the end of the last stage both disarmament and inspection would be complete.

• *RANDOM INSPECTION*

The third approach to progressive disarmament and inspection would substitute for free selection of a zone by the international disarmament organization a random method of selection. It might be argued that giving the right to choose a zone to the international disarmament organization or to a group of nations might increase the chances that a particular selection would be based on data supplied by military intelligence or would be directed toward obtaining such data. On the other hand, if a zone were selected by lot, the danger of espionage would be reduced. This method of selection would, however, make difficult the process of utilizing the selected zone for the purpose of obtaining leads about possible violations in another zone. For instance, an inspection of a closed factory of certain components of military airplanes might disclose that many such components have been shipped to a factory in another zone which is not on the list presented by the inspected country. It might be hard enough to wait until the inspectorate would be permitted to choose another zone during the next disarmament period; it would create an unbearable strain on the whole disarmament process if the inspectorate had to wait until fortuitous chance would let it enter the suspected zone. This might be remedied by devising separate methods for dealing with a suspected violation of the disarmament treaty. If, for instance, the disarmament treaty would permit a limited number of inspections of factories outside the selected zone with respect to which prima facie evidence could be presented that prohibited activities seem to be conducted in them, then it might be easier to select the zones by a random method. Such factory inspection should not be at the discretion of the international disarmament organization or of any group of parties to the disarmament treaty; a special tribunal might be established to sift the evidence and to decide whether the proof is strong enough to warrant an extrazonal inspection.

• *ZONAL DISARMAMENT AND INSPECTION*

Another division of zonal proposals can be made on the basis of the intensity of the link between disarmament and inspection. Some of the early proposals insisted that the zone inspected must be disarmed. A few of them would permit the disarmament of a selected zone prior to its opening for inspection. Others would require its disarmament while it is being inspected or

(Continued on page 10)

COMPARISON OF DISARMAMENT TREATIES

A summary comparison of the U.S. and USSR Treaties on General and Complete Disarmament, as submitted to the eighteen nation Committee on Disarmament at Geneva, Switzerland, March and April, 1962. The full texts may be secured from the U.S. Arms Control and Disarmament Agency, Washington, D.C.

United States—STAGE I	**Soviet Union—STAGE I**
International Disarmament Organization: Establishment of IDO within framework of the UN. Composition—General Conference of All Parties, Control Council consisting of representatives all major signatory powers as permanent members and other Parties on rotating basis, an Administrator with authority to ensure effective and impartial implementation; verification functions specified for each disarmament measure. Guarantees against clandestine activities presented by an arrangement embodying selected inspection by means of agreed zones, randomly selected.	**International Disarmament Organization:** Establishment of IDO within framework of UN. Composition—General Conference of all Parties, Control Council consisting of five permanent members of the Security Council and other Parties elected for two years with proper representation of the three principal groups of states, no administrator mentioned but specifies Control Council staff represent three principal groups of states and recruit from persons recommended by governments; verification functions as stated in treaty, directing control measures over implementation.
Armed forces: U.S. and USSR force levels reduced to 2.1 million; other Parties to 100,000 or one per cent of population.	**Armed forces:** U.S. and USSR force levels reduced to 1.7 million; other Parties to be specified.
Armaments: 30 per cent reduction of categories specified; such armaments placed in IDO depots pending destruction or conversion.	**Armaments:** Reduction commensurate with force levels; reduction supervised by IDO.
Nuclear delivery vehicles: 30 per cent reduction of categories specified; IDO supervision of destruction or conversion.	**Nuclear delivery vehicles:** All rockets, artillery systems, military aircraft eliminated as well as launching pads, silos, and platforms. IDO supervision of destruction or conversion.
Nuclear weapons: Halt production of fissionable materials for use in nuclear weapons; declare all facilities to IDO and establish agreed levels for peaceful purposes; Parties will not transfer control over nuclear weapons nor transmit information for manufacture to non-nuclear states; safeguards for transfer of fissionable materials between states to be worked out with International Atomic Energy Agency; all nuclear weapons test explosions prohibited.	**Nuclear weapons:** Parties will not transfer control nor transmit information on manufacturing to non-nuclear states; all nuclear weapons test explosions prohibited.
Withdrawal of foreign troops and dismantling of bases: no mention.	**Withdrawal of foreign troops and dismantling of bases:** All foreign troops evacuated and installations and armaments destroyed; granting of military bases or bilateral or multilateral treaties prohibited; IDO to control and inspect.
Outer space: Prohibition of weapons of mass destruction in orbit; notification and pre-launch inspection; production, stockpiling and testing of boosters for space vehicles subject to agreed limitations; monitored by IDO.	**Outer space:** Prohibition of placing in orbit devices capable of delivering weapons of mass destruction; production, testing of rockets for peaceful exploration subject to supervision of IDO.
Control measures and keeping of the peace: Establishment of IDO; report on military budgets; advance notification of military movements; establishment of observation posts; exchange of military missions; rapid and reliable communications between heads of governments and the UN; establishment of International Commission on Reduction of the Risk of War; study of codification and progressive development of rules of international control related to disarmament; refrain from indirect aggression and subversion; disputed treaty interpretations referred to International Court of Justice; support General Assembly study on new procedures for peaceful settlements; plan UN Peace Force for Stage II; establishment of UN peace observation corp.	**Control measures and keeping of the peace:** Establishment of IDO; report on military expenditures; notify IDO on military movements and launching of rockets; provide armed forces for UN security force; strengthen UN as principal institution for maintenance of peace; base all international relations on coexistence and cooperation; Parties not to use military forces except for internal order or to discharge obligations to UN.
Transition: Stage I to consist of three one-year stages. During last three months, IDO Control Council to determine whether all agreements fulfilled and preparations for Stage II completed. All militarily significant states Parties to the treaty. If permanent member does not find treaty conditions completed, matter placed before Security Council.	**Transition:** Stage I initiated six months after treaty in force; Stage I to last 15 months. During last three months, IDO to review implementation and report to Parties, Security Council, and General Assembly. Stage II to begin when all Stage I measures completed and preparations for Stage II are finished.

United States—STAGE II

Armed forces: Reduction to 50 per cent below Stage I levels; other Parties to be further reduced; agreed limitations on military training.

Armaments: Reduction to 50 per cent below Stage I levels; additional armaments subject to 50 per cent reduction as specified: Halt manufacture within agreed limits; halt development, testing of new weapons and light testing of existing types of missiles limited; cessation of all production and testing of chemical and biological weapons and reduction of existing stockpiles of such weapons by 50 per cent, conversion of such laboratories to peaceful purposes.

Nuclear delivery vehicles: Declaration to IDO of all types; reduction by 50 per cent from Stage I of inventory of each type as specified.

Nuclear weapons: Declaration to IDO of amounts, types and nature of all fissionable materials; reduce such materials for nuclear weapon use to minimum levels; destroy non-nuclear components and assemblies of nuclear weapons; registration of nuclear weapons for verification purposes.

Withdrawal of foreign troops and dismantling of bases: Parties would dismantle and withdraw according to agreed limits.

Control measures and keeping of the peace: Expand steps set forward in Stage I, incorporating new arrangements as determined by International Commission on Reduction of the Risk of War; Parties to adopt such rules of international conduct necessary to begin Stage III; United Nations police force to exist within first year of Stage II.

Transition: Stage III to begin when all undertakings of Stage II completed, preparations for Stage III made, and all states possessing armed forces and armament are Parties to treaty. In last three months, Control Council to review. If permanent member does not find treaty conditions completed, matter placed before Security Council.

Soviet Union—STAGE II

Armed forces: U.S. and USSR force levels reduced to one million; other Parties to be reduced.

Armaments: Reduction commensurate with force levels; manufacture curtailed; all chemical, biological and radiological weapons eliminated and laboratories converted to peaceful purposes.

Nuclear delivery vehicles: Completed in Stage I.

Nuclear weapons: All nuclear weapons eliminated and non-nuclear components destroyed; fissionable materials for peaceful use only; IDO to inspect; Declaration to IDO on nuclear raw materials, processing and utilization for military or peaceful purposes.

Withdrawal of foreign troops and dismantling of bases: Completed in Stage I.

Control measures and keeping of the peace: Strengthening of steps outlined in Stage I with emphasis on Security Council's armed forces.

Transition: Stage II to take 15 months. During last three months IDO review implementation and report to Parties, Security Council, and General Assembly; Stage III to begin when all Stage II undertakings completed and preparation for Stage III finished.

United States—STAGE III

Armed forces: Complete reduction to agreed levels for maintenance of internal order and manpower for UN Police Force; halt all military conscription.

Armaments: Reduction to agreed types for internal forces; halt all research, development, testing and convert to peaceful uses.

Nuclear weapons: Eliminate all remaining nuclear weapons and transfer materials to peaceful uses.

Nuclear delivery vehicles: Complete reduction by steps laid out in Stage I and Stage II.

Withdrawal of foreign troops and dismantling of bases: All remaining bases dismantled and converted except those agreed for maintenance of internal order.

Control measures and keeping of the peace: Parties report to IDO all scientific and technological discoveries having potential military significance; parties support full international cooperation in all fields of scientific research and development; continue extending and promoting confidence among nations, reducing risk of war; strengthen IDO and UN Police Force so that no state may challenge them.

Completion of Stage III: Following time period agreed upon, Control Council determines whether all undertakings carried out; any permanent member may question and matter submitted to Security Council.

Soviet Union—STAGE III

Armed forces: Complete reduction to agreed levels for maintenance of internal order and manpower for UN Police Force; abolish military training and conscription and war ministries and processes of military and paramilitary institutions.

Armaments: Reduction to agreed types for internal forces; halt all weapons development.

Nuclear weapons: Completed in Stage II.

Nuclear delivery vehicles: Completed in Stage I.

Withdrawal of foreign troops and dismantling of bases: Completed in Stage I.

Control measures and keeping of the peace: Internal police forces established by treaty; plants manufacturing arms inspected by IDO; assistance, appropriate facilities and internal forces available to Security Council Force; all internal police forces subject to control of IDO with right of aerial inspection.

Completion of Stage III: Stage III to be completed in one year; IDO review implementation and report to Parties, Security Council and General Assembly.

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after the accuracy of the inventory has been checked. Prior disarmament of a sealed off zone would best safeguard military secrets; disarmament after a careful check of the list of weapons and factories would establish the veracity of the inventory and would diminish tensions resulting from the fear of hidden weapons.

The United States proposals of April 18, 1962, make disarmament independent from inspection. In the example previously discussed, in the first year a nation would have to destroy ten per cent of its weapons and would have to open one of ten zones to inspection. If the inspected nation should feel that the weapons in the selected zone have been "contaminated" by inspection and would be, therefore, of only a limited use to it in the future, it might prefer to use them to fulfil its obligation to disarm. Should the weapons in the zone exceed ten per cent of its inventory, the nation could keep the remainder and even transfer it to other zones once these weapons have been checked against the list. On the other hand, if the weapons in the zone are not sufficient to fulfil the ten per cent quota, the inspected nation would have to bring additional weapons into the zone for destruction or invite the inspectors to witness the destruction of such additional weapons in some other zone at a place selected freely by the inspected nation. Finally, this proposal would permit a nation which would prefer for security reasons to retain certain armed forces and armaments in the selected zone, to keep them there, provided that it would fulfil its ten per cent quota by destroying weapons elsewhere under the supervision of the inspectors.

In this way, the new American proposal removes the unnecessary rigidity of the old ones and at the same time retains a close link between the extent of inspection and the amount of disarmament. Under this proposal, disarmament and inspection remain parallel even though they need no longer be territorially coextensive. Their progress would also continue to be linked, as each new cut in armaments would result in opening a new territory to inspection until in the last period the remainder of arms would be destroyed and the remaining territory of each nation opened to inspection.

Most of the previous discussion was based on the assumption that all nations of the world would accept the obligations of the disarmament plan. The discussions at Geneva, however, seem to consider the possibility that some important nations might not participate in the early stages of disarmament. In particular, the United States proposals of April 18, 1962, provide that the first stage of the treaty (i.e., a thirty per cent cut in armaments) would be started upon the ratification of the disarmament treaty by the United States, the Soviet Union, and by "such other states as might be agreed." Only in the second stage would accession by "all militarily significant states" be required. Consequently, it would be possible to start the disarmament process without the participation of several militarily significant states such as France or the People's Republic of China. In such a case, it might be necessary to make some adjustments in some of the proposals for progressive zonal disarmament and inspection, though some of them should not run into any difficulties.

In the systematic approach, for instance, the United States might be reluctant to remove its forces from bases on the periphery of Asia as long as China would be exempt from any obligation to disarm. Similarly, regardless of the similarity between the political and economic systems prevailing in the Soviet Union and China, the Soviet Union might not wish to create a military vacuum on its side of the long Chinese border. Analogous difficulties would arise with respect to those selective and random methods in which disarmament and inspection are closely linked. On the other hand, the recent United States proposals seem to avoid this difficulty, since under them a nation would not be required to disarm any selected zone if it should think that its security would be endangered thereby. It can destroy, instead, equivalent armaments in some other zone and thus fulfil its current obligation to disarm by ten per cent without denuding a crucial border zone.

Some of the possible variations of the proposal for progressive zonal disarmament and inspection have been outlined. The whole subject needs further intensive study before a final solution has been achieved. Even a preliminary investigation shows, however, that this proposal seems to lead in the right direction of relating inspection to disarmament in a meaningful way. It allows a nation to guard a preponderant proportion of military secrets against foreigners in the early stages when only small cuts are made in strategic forces. On the other hand, this proposal ensures that when these cuts would become significantly deeper, progressively extended inspection would diminish the risk inherent in such cuts.

It is conceivable that the same results might be achieved through some other method, but until a better way is found to deal with the complex problem of the link between disarmament and inspection, no nation should reject the opportunity of exploring further the possibilities of the proposal for progressive zonal disarmament and inspection. The many permutations through which this proposal has gone over the last few years show the inherent flexibility of this method and its adaptability to various substantive disarmament proposals differing widely in scope and depth. A careful study of it on the intergovernmental level would, therefore, seem desirable. Such a study might lead to a new proposal, one entirely different from any here considered. But this is not important. What matters is that the two sides should approach the problem in a spirit of mutual understanding of their respective preoccupations and anxieties. Once that spirit manifests itself, the technical solution will not be far behind.

IGOR GLAGOLEV

Is Disarmament Practical?

The continuation of the arms race and political and military conflicts in different parts of the world make some people think that disarmament is not practical. These doubts are reflected, for instance, in the comments of the leading American newspapers on the new disarmament plan, prepared by the United States Arms Control and Disarmament Agency. The difficulties on the way to disarmament are evident to anybody. But to my mind disarmament is not only practical but necessary if mankind has the will to survive and to improve its living conditions.

The danger of nuclear war may grow even in spite of the intention of the Soviet and American governments to avoid war. The increase of the number of nuclear powers and of the persons who have nuclear weapons at their disposal means that the possibilities of nuclear war for a variety of reasons also increases. The nuclear war may begin because of local conflicts, miscalculation, misinterpretation of the intentions of the other side, fanaticism of some officers, etc., etc. Today the possibility of nuclear war may be one in a hundred or one in a thousand. But in a few years it may be much greater if some radical measures leading to disarmament and the prevention of war are not taken. These measures must include not only cuts in armaments but also organization of international security and international control over disarmament and—last but not least—important changes in political thinking, in the psychology of man. To put it roughly, many people will think: the more armaments the more security. This theory is entirely wrong. The contrary is true: the more disarmament the more security. (I speak of general disarmament, not unilateral steps.)

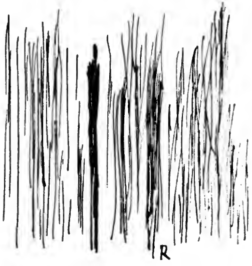
The advocates of increased war budgets tell us that these expenditures are necessary to build second strike forces, that is, forces which cannot all be destroyed by the first strike of the enemy and which will be able to retaliate in kind. But in fact both sides already have such forces. For example a significant part of the strategic forces which now exist constantly moves in the atmosphere, in the water, and perhaps in space, and it is practically impossible to locate precisely all the means of retaliation at a given moment and to destroy them simultaneously.

The advocates of armaments tell us also that modern arms are costly. But in terms of killing power and in relation to increased gross national product, nuclear weapons are far cheaper than conventional arms. For the money already spent, the world has acquired the means to destroy billions of people. Of course we can spend much more and make it possible to destroy the population several times over. But is it necessary?

The advocates of the arms race tell us now that large sums of money must be spent on the development of shelters which already can be seen everywhere in the United States but not in the Soviet Union. But taking into consideration the speed of rockets, will we have time to go into these shelters without being crushed in the stampede toward them? And in the improbable case that the rocket war will proceed very slowly and orderly and that everybody will quietly go into a shelter, will we be able to get out of it after the explosions of many multimegaton bombs or warheads and after huge firestorms? Will not these shelters be buried under mountains of radioactive dust, bricks, and stones?

We are told that the arms race is necessary to improve armaments to get more effective means of destruction. Yes, it is possible to develop the means of mass annihilation, to invent new ones. We may even invent such means which we shall not be able to control. But this is just the reason why we must stop this race before it is too late.

When the governments cut their armed forces they usually reduce the relatively obsolete part of them. It is not, of course, real disarmament. But such a measure as the ban on nuclear tests which was successfully tried in 1959 has results of a different kind. It was a serious obstacle to the development of most effective nuclear arms. It made possible stabilization of arms expenditures and in the Soviet Union in 1960 a significant reduction of armed forces as a whole. It helped to create a favorable international situation for our prime minister's visit to the United States and for the conclusion of the Antarctic treaty. And we were very sorry when in 1960 the United States government officially an-



nounced that the moratorium had come to an end and began preparations for tests in Nevada. We are also sorry that first France, then the Soviet Union, and now the United States and Britain tested their nuclear weapons. And we think that it is possible and necessary to stop the new wave of armaments and nuclear tests.

And is it not better to take some money from the growing war budgets, from the deliberate preparations for a gigantic suicide and use it in a more reasonable way—say, for the study of disarmament and international security? Such studies are being organized now, but if we compare the sums spent for this purpose with the military budgets we shall soon see the difference. The war budget of the United States for instance is more than two thousand times greater than the budget of its disarmament agency.

Reduction of armaments, stabilization of arms expenditures on a relatively low level, various anti-war steps, and collective agreements are not fantasy. They are quite practicable measures which have occurred in the past as often as wars.

The Soviet government has suggested banning the use of nuclear weapons. Such a ban is not fantasy, for it has been reality since 1945. But it is unstable. We must have general agreement on it; we must make it durable.

The Soviet government has suggested creation of denuclearized zones. Such zones already exist. But our task is to enlarge them, to make them durable. Is it possible, for instance, to denuclearize the whole continent of Africa? Yes, it is. The agreement between the United States and Morocco on the liquidation of American strategic bases in Morocco will be helpful in this connection. And the Soviet Union wants no bases on foreign territories for its nuclear forces. The reader may remember the liquidation of Soviet foreign bases.

The Soviet government has also suggested, to prevent further spread of nuclear arms, not giving nuclear arms or information on their production to non-nuclear states. It is quite a practicable measure in the interests of both of our countries.

If we consider the possibility of an agreement on the nuclear test ban, we shall see that the differences between the positions of our countries are not so insurmountable as they may seem. The United States and Great Britain offered to conclude an agreement on the ban of tests in the atmosphere controlled by national means of detection. The Soviet Union proposed banning all tests, using the same means of control. Now the neutral countries suggest supplementing these proposals by organizing a group of scientists for verification of the necessary data. Experience proves that all kinds of tests—in the atmosphere, underground, in space—have been detected by the national means and if we negotiate more energetically we can combine the present suggestions and reach an effective agreement. All national means of detection and verification—including a large variety of instruments, analysis of the huge amount of economic data, scientific exchange, and a worldwide system of diplomatic representatives, press correspondents, and tourism—are now supplemented and united by a system of international organizations.

The fact is that we already practically have a system of international control which may not be ideal, not one hundred per cent effective, but it is very important. The majority of the so-called military secrets are in fact not secrets at all.

Of course any agreement on disarmament must be connected with measures providing for the effective control of the fulfilment of this particular agreement. We must develop the existing means of international control. But we must remember at the same time that it is impossible and it will be impossible to create an ideal, one hundred per cent effective system of international control. Even governments cannot fully control the actions of every citizen in their own countries. If they could there would be, for example, no crime.

The main basis for an agreement or agreements on disarmament is not an ideal system of control, but common interests in preventing war and in converting military expenditures to the development of economy, science, and culture. This is also recognized by such American experts on disarmament as John J. McCloy.

I have spoken of some measures leading to disarmament. These measures should be considered in connection with other steps and eventually with general and complete disarmament, which is the radical solution of the problem of lasting peace and which is more effective in this respect than any partial measures. If we take some anti-war measure today and drop it tomorrow or if we stop production of one weapon and develop production of another weapon, we shall not solve this problem. Disarmament must be viewed as a process, a logical series of steps in one direction—toward general and complete disarmament with a far-reaching system of international control and international security.

We have an agreement on the main principles of general and complete disarmament. The agreement is theoretical as yet, but theory is very important for practical purposes as every scientist knows. I should like to stress the agreed principle that the control system must correspond to the measures of disarmament taken at a given stage. It means that the control system will grow as the scale of disarmament will grow. It means also that we can begin with those measures which are easier to control, which require relatively small additions to the existing means of control.

Let us consider, for example, such a step as freezing of military budgets. Governments very often stabilize their military budgets or even cut them, sometimes drastically, without any definite international control. It does not mean that they have no knowledge of the military policy and military expenditures of other states at this time. Usually they use their national means of information to make sure that the other governments do not increase the war preparations. Why not try this method now, why not try to improve it by concluding in official worldwide agreement and maybe supplementing the existing detection means by some international budgetary control? If we stop the increase of military expenditures, the international atmosphere and the possibilities for other agreements will significantly improve, and the percentage of military expenditures in the gross national product will decrease simultaneously with the growth of production.

Or take the ban on nuclear tests. Many experts on military problems and disarmament agree that not only tests in the atmosphere but also in water and in space can be detected by existing means. They also agree that large underground tests, significant from the military point of view, will be detected. Then only the problem of small underground tests remains, but the fact that the United States and some other countries began a large scale development of their almost worldwide network of seismic stations proves that the detection possibilities will be significantly improved in the near future. Of course the possibility will always remains that somebody will secretly test one or two tiny bombs. This will be possible for both sides. But it is highly improbable that a militarily significant series of tests will pass unnoticed. Practice proves that all the nuclear powers had to test in open, evidently having no way of hiding their tests.

Some people say that one side could prepare tests secretly and this would be dangerous for the other side. But why not let both sides be prepared for tests but not test—if both sides are stupid enough to waste their resources in this way? In any case, I think that to break an official worldwide agreement will be far more difficult than to announce the end of a tacit moratorium.

If we decrease international tension it would be easier to prevent so-called local wars, or if they start, to stop them. Several wars after the Second World War were stopped by an international agreement and not by a surrender of one side as in the past. I think that this fact is very important, and we must use this method of negotiation in the future.

The attempts of some colonial powers to use armed force to prevent the liquidation of colonialism caused wars, during which the sympathies of our country was on the side of those who fought for the liberty and independence. I think that both the United States and the Soviet Union are interested not in escalating such wars but in liquidation of colonialism—which is a historic necessity—by peaceful means.

I should like to stress also the role of scholars in finding the best ways to disarmament and peace. Problems of disarmament are difficult in the present complicated international situation. Careful, professional studies are required. Disarmament is not only a political but also a scientific problem. If we consider for instance the economic aspect of disarmament we shall soon see the necessity for preparation of plans for the conversion of war industry. The economists must already now begin to look for the best, most rational methods to use the resources which will be freed by disarmament. Some preparatory work in this field has already been done at the Kiel conference in 1961 and at the meeting of the United Nations experts on the economic and social consequences of disarmament this year. And both conferences reached unanimous conclusions and practical suggestions. There is a plan to organize an international study group on disarmament. To my mind it would be an important step in the necessary direction.

International cooperation of seismologists, for instance, can help to coordinate the work of national systems of seismic stations and solve the problem of control of significant underground nuclear tests. Cooperation of nuclear physicists will be helpful for finding peaceful uses of plutonium and methods of nuclear disarmament and control, which is to my mind the heart of the problem of general and complete disarmament. By the way, control over the nuclear industry is quite feasible, and specialists on disarmament and nuclear physicists share this opinion.

The studies of disarmament should concentrate in those fields where we have evident common interests and a large measure of agreement. We must also separate real differences and difficulties from imaginary ones. If we concentrate only on difficulties, if we demand more and more control from the very beginning, we shall only endanger the political and scientific negotiations. Anybody can find obstacles to disarmament in any newspaper. Anybody can invent many additional difficulties. But the task of scholars is to find some common ground, some practical ways to begin the disarmament process as quickly as possible. In fact we have made already a successful laboratory experiment on general and complete disarmament under effective control and with an official international agreement. I speak of the Antarctic continent. Of course the methods used there must be developed for use in industrial, densely populated countries. Let us begin a chain reaction of disarmament, starting from this nucleus. And we must hurry, because the more arms of mass destruction we have the more difficult it may be to destroy them and to organize an effective international control. Reason must triumph over the dark forces of destruction.

Disarmament and Strategy

HANS A. BETHE

In the fall of 1961 the United States was deeply stirred by the Russian atomic weapons tests and by the debate on fallout shelters. Nuclear war suddenly seemed very real. I believe one should not shrink from contemplating the realities of nuclear war but I also believe that, through the particular development of strategic weapons during the last few years, nuclear war is becoming less probable every year. This development, tending toward invulnerability, will create a much greater military stability, and is a good starting point for meaningful disarmament negotiations.

The need for disarmament, for a halt to the arms race, was dramatically illustrated by the Russian test of an atomic weapon of 60-megaton yield last October. Shortly before this test, Mr. Khrushchev announced that by testing a weapon of 50 megatons the Soviet Union would prove at the same time the design of a weapon yielding 100 megatons.

100 megatons is a formidable weapon. The strongest effect of such a mammoth weapon is to set fires, and this effect is increased by exploding the weapon at high altitude, let us say 30 miles. The book *Effects of Nuclear Weapons*, published by the Atomic Energy Commission and the Department of Defense in 1957 and revised in April 1962, indicated that on a clear day wooden houses and forests may be set on fire by such an explosion to distances of about 30–50 miles from ground zero, and highly inflammable materials like loose paper, oil-soaked rags, etc., to greater distances. It is quite possible that a firestorm will also result but the conditions for firestorm have never been clearly determined. On the other hand such an explosion at high altitude will not cause appreciable fallout; this will only be produced by explosions at or near the ground.

Blast will be small from an explosion 30 miles up. But if the explosion is set off at only a few miles elevation, dwelling houses will be destroyed by blast up to about 20 miles distance. It is clear that one such weapon could wipe out any one great population center.

From the military point of view there is not too much difference between weapons of 100 megatons and of 10. 10-megaton weapons have existed for a long time, and 10 megatons is enough to destroy any big city. At 10 megatons, the most important destructive mechanism is probably still blast. The weapons effect handbook mentioned above shows that a 10-megaton weapon, exploded close to the ground, will give a pressure of three pounds per square inch at a distance of nine miles. This pressure will do severe damage to wooden frame houses as well as to brick buildings. Reinforced concrete buildings are able to stand several times this pressure. Assuming a destructive radius of 10 miles, a 10-megaton bomb exploded at the southern end of Central Park would destroy all of New York City except for a few outlying districts like Coney Island. Maybe it is good that the Russian test has finally made the world really aware of the mortal peril in which we live.

• *THE BALANCE OF TERROR*

In 1950, after the first Russian tests of fission bombs, the United States thought that terror must be met by greater terror, A-bombs by H-bombs. As could have been expected, the Russians soon also developed H-bombs. Thus a balance of terror was created, and both sides adopted a strategy of deterrence: neither side can damage the other without suffering terrible retaliation. The horrible weapons then exist only in order that the other side does not use them. I do not see how this precarious situation can be changed until these armaments can be eliminated by enforceable disarmament.

Under the pressure of the Korean War with its heavy loss of American lives, Dulles formulated "the doctrine of massive retaliation"—i.e., Communist attacks on the periphery of the free world would from now on be answered by atomic bombs on Russian or Chinese territory. This is a most pernicious doctrine because it means deliberate escalation of a small war into a big one. It was, I believe, also a short-sighted doctrine because it was already clear in 1954 that Russia would soon get the H-bomb.

The massive retaliation doctrine has now been turned back on us. After the U-2 incident Khrushchev threatened to attack with rockets, presumably with thermonuclear warheads, any country which would serve as a base for U-2 flights over Russia. Thereby he adopted the same doctrine of escalation of a small act into a big war. Recently he went further by threatening to use his 100-megaton bomb against the West in case of war.

We thus see that both Eastern and Western statesmen are using the word retaliation for two entirely different concepts. One is retaliation against an enemy attack by H-bombs. Our capacity to retaliate in such a case is vital to us, it is the only *military* force which prevents a potential enemy from making an attack. The other is massive retaliation against minor wars. This concept, I believe, must be removed from our military doctrine, both for practical and for moral reasons.

• *COUNTERFORCE AND INSTABILITY*

With H-bombs in possession of both sides, it is obviously tempting for a country to try to remove the retaliation capacity of another country, i.e., to destroy the enemy's war-making capability at the outset of war. This is known as the strategy of counterforce. In the mid-1950s, when planes were the only vehicles capable of delivering large bombs, the destruction of the strategic enemy planes was a great prize. If a surprise attack succeeds in destroying the enemy planes on the ground, clearly the deterrent no longer exists, it has failed. The country striking first wins the war.

There are two possible defenses against such a calamity. The more obvious one is air defense, i.e., the attempt to shoot down invading planes by fighter planes or antiaircraft rockets. These forms of air defenses were developed by both sides; in fact the Russians used a much larger fraction of their military budget than we did. It is not now clear to what extent their defenses, or for that matter ours, can be penetrated by invading planes.

The second measure against surprise attack is to put one's strategic bombers on alert. For this and other purposes, such as civil defense, we constructed a radar warning system known as the DEW line, Distant Early Warning, which is strung out along the northern edge of the North American continent. It would give two or three hours warning time of enemy planes approaching. In case of such warning our strategic bomber force would take off and fly north, loaded with bombs. Since a radar warning can be caused by all sorts of things besides enemy planes, such as a flock of birds or certain kinds of radio noise, the force is under instructions that it may not proceed beyond a certain line without a specific command from the President of the United States. This is known as fail-safe and I hope the name is justified.

Thus defense against a surprise attack by planes has gradually been strengthened by air defense and by the alert. However, the situation was changed again drastically in favor of the aggressor with the advent of the ICBM, the Intercontinental Ballistic Missile. When the Russians tested their first ICBM in the summer of 1957 they tipped the scale heavily in their favor. They were so far ahead of U.S. development in this field that many Americans, both military and civilian, could not believe the intelligence reports until Sputnik appeared in the sky. Sputnik greatly accelerated our military research and development, especially our own development of ICBMs so as to reestablish the balance of strategic forces. Further, Sputnik induced great improvements in the organization of science in the U.S. government, both on the presidential level and in the Department of Defense.

But while its indirect effects on the United States may have been beneficial, the main effect of ICBM was to make surprise attack much easier. We developed a radar warning system also against missiles, called BMEWS, Ballistic Missile Early Warning System, but the warning is not very early. It takes about 15 to 20 minutes from the time BMEWS sees a missile to the time the missile arrives in the United States. Fifteen minutes is better than nothing and accordingly SAC has many bombers on ground alert such that they can take off on a 15 minute warning. Also, at any one time some bombers are actually in the air. In this way we are protecting, at least in the interim, our strategic retaliatory capability.

Our own first operational missiles are just about as "soft" as planes, i.e., they are above ground so that an H-bomb dropped many miles away will destroy them. This vulnerability tempts the enemy to use counterforce, and our own strategists to get our missiles off before they can be destroyed, in other words, to shoot on the basis of radar warning alone. Even though it is the constant endeavor of radar engineers to minimize false alarms, to my knowledge they have never been completely eliminated. Clearly it is far more dangerous to launch a missile attack than to let the planes take off. The planes can be recalled, the missiles cannot.

It will be seen that coupled with the highly mechanized pattern of our systems necessary to achieve the desired rapidity of response, the whole counterforce concept has become extremely dangerous. Any accident may trigger the nuclear holocaust. Even the most peaceful nation may be induced to start a war if information is received indicating that the enemy is about to attack —and this information may be wrong. Once war starts, each side will be inclined to use a maximum of striking power because whatever is not used immediately may be destroyed by an enemy strike in the next hour. Thus the situation is highly unstable, accidental war is not unlikely, and if war comes it is immediately full scale.

Moreover, if you expect that perhaps only 10 or 20 per cent of your force survive the beginning of the war, then you must provide for a force which is five or ten times as big as what you think you will actually need. We have a force of about 500 B-52 heavy bombers, and about 1000 B-47 medium bombers. The Russian forces presumably are less but still formidable. Let's assume a B-47 carries only 10 megatons and a B-52 twenty, then the bombs which can be carried in planes alone are 20,000 megatons. And since 10 megatons will destroy any large city, it is quite clear that these forces are far beyond anything that can reasonably be considered necessary for war.

Counterforce strategy puts a premium on the first

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strike, it thus makes war more likely, and increases the level of strategic forces beyond reason.

- *STABLE DETERRENT*

The military problem of the last few years then was to make the retaliatory force survive an initial attack. The solution which is just being put into effect, is to put missiles, especially Minuteman and Titan, into hardened underground silos. These silos can survive a blast pressure of at least 100 pounds per square inch, probably more. An explosion of 10 megatons causes a pressure of 100 pounds per square inch at a distance of 1½ miles. Therefore if silos are spaced more than three miles apart it is impossible by one attack of 10 megatons to destroy two Minutemen at the same time. In other words it would take at least one 10-megaton warhead to eliminate one "tiny" Minuteman, or several smaller warheads aimed with an accuracy at present probably not obtainable. The precise location of all these silos would have to be known to the attacking enemy, which is very unlikely even in the "open" United States. The difficulty is compounded by the fact that at least at present the distance between points in the U.S. and the USSR is apparently not known to as good an accuracy as one mile. It is reasonable to assume then that hardening to 100 pounds per square inch and proper spacing between the Minuteman and Titan silos will make our launch sites essentially invulnerable to enemy attack. The situation would not be changed if 100-megaton weapons were used: it might perhaps be possible to destroy two little Minutemen with such a large missile. It seems clear that a hundred missiles of one megaton each constitute a far stronger force than one missile of 100 megatons.

Our Minuteman is propelled by solid fuel which makes it instantly ready for take off. The first tests of Minuteman have been very successful. I believe that in spite of our later start on intercontinental missiles, we now are building a more useful missile force than the Russians have at present. Of course they may change their force, which I will consider. According to reports in the papers we also have at present an edge in the number of missiles actually deployed. This then is a grim note of hope, namely that we have a force which will prevent any rational enemy from thermonuclear attack.

Even more invulnerable than the Minuteman is the Polaris missile also propelled by solid fuel. To be safe from counterattack by Polaris submarines, an enemy would have to find all or nearly all of them: it is notoriously difficult to locate submarines. At present we have on station Polaris submarines capable of launching about a hundred missiles. By means of Polaris and the hardened Minuteman, the premium on a first strike is essentially removed, the danger of surprise attack is greatly reduced and so is the instability of the world. If the Russians should also develop and come to rely on a similar type submarine they might be less nervous and this would be favorable for our interests too. Polaris and Minuteman together offer us a rather secure second strike force. Of course any force can be used for a first strike, but a first strike by small missiles will be limited. If a country is mainly interested in first strike and aggression, the large 10- and 100-megaton warheads will be more effective than small ones, and it will not need to make its missiles and planes invulnerable. On the other hand if we reduce our force essentially to a second strike force, this will be one of the best demonstrations that we are only interested in defense and not in first attack.

The Russians have until now sought to protect their strategic force by secrecy. If we do not know the location of their airfields and missile sites, we can obviously not launch a successful counterforce strike. In their recent nuclear test series, however, there may be some indication that they may in the future adopt methods more similar to our own. The series included many tests in the range from about one to about five megatons which is just the range which might be suitable for a Russian second strike missile in hardened sites. I hope very much that this is the right interpretation of this phase of their test series, and that the Russians are also aiming for an invulnerable second strike force, not for a first strike force. In this case this major part of their test series may well have reduced the danger of war.

The fact that the striking force can be made secure against surprise attack should make it possible to greatly reduce its size. As I said before the large size of our present strategic force is justified mainly by the expectation that only a fraction of the force would survive surprise attack by the enemy. When missiles are essentially invulnerable you need much fewer, and it becomes possible to slow down the arms race, even without a formal treaty on arms limitation. However, in order to feel safe in limiting the size of its forces each side must feel sure that the other side does not have vastly superior forces. I said that one 10-megaton weapon if properly aimed might destroy one of our Minuteman sites. If the number of large Russian ICBMs were to exceed greatly the number of our hard missile sites then we would have to increase the number of our missiles as well. It is very important, therefore, that both sides observe restraint by deploying primarily small missiles and limiting their number. In the past the Soviet Union has followed a policy of deploying only limited numbers of planes and missiles. If we have a fairly good knowledge of their strength we also can limit the strength of our forces; if not, we must prepare on the assumption of the worst possible case. This is one strong reason why the excessive secrecy of the Soviets is very damaging to the cause of peace, and often against their own interests. In the past when we got information on Soviet military strength such as from the U-2 flights, this often led to a limitation of our own military preparations, and thus in an indirect way reduced world tension.

Another desirable consequence of the invulnerable missile site, and of Polaris, is in fact that secrecy loses most of its value. If the sites can not be destroyed by available numbers of atomic weapons, then it is no longer useful to know where they are. This should make it possible both for ourselves and especially for the Russians to greatly reduce secrecy. I believe that openness should be possible in a world armed with invulnerable missiles, and not only in a disarmed world as Khrushchev has said.

The concept of the invulnerable missile force has sometimes been attacked as a Maginot line philosophy. There are decisive differences: From a hardened missile launch site you can counterattack the enemy anywhere, even in his homeland, from a Maginot fortress you could not. Once the Maginot line was breeched the remaining fortresses were useless in stemming the enemy advance (in fact the Maginot line was not breeched but circumvented because it was incomplete at its Western end). Each individual Minuteman silo can act on its own even if others are destroyed. Of course just as in the case of the Maginot line technological changes might make missile silos vulnerable.

It will always be necessary to know the changing threat from the potential enemy and to adjust the structure of strategic forces to the changes. For instance, the recent Soviet tests may require certain modifications in the details of our military planning in weapon systems, even if they have not changed the fundamental soundness of our plans for an invulnerable missile force.

However, the invulnerable deterrent has at least one disadvantage. As long as the strategic force consists of planes which can easily be destroyed, they will draw the enemy fire. In fact many strategic analyses have assumed that if there is a war, then the fire will be concentrated entirely on military targets. However, once these military targets are effectively invulnerable, then to be destructive an enemy will probably concentrate to a larger extent on bombing cities. This is most unfortunate and against the sound military tradition of trying to destroy the enemy's war-making capability. But I believe we have no choice but to accept this drawback of the stable deterrent.

The invulnerable deterrent clearly has an important effect on civil defense. We have just had a long and bitter debate about fallout shelters. Some magazines and widely publicized articles argued that once each of us has a shelter we can await thermonuclear war with calm and 97 per cent will survive. Others, somewhat less loudly, claimed that fallout shelters were totally useless. A few took a middle course, as did the useful pamphlet on shelters recently published by the Department of Defense.

Whether shelters are useful or not depends of course on the kind of attack against which they have to protect. If the attack is exclusively on military targets, if the bombs are all exploded on the ground, and if there is only one major strike then fallout shelters will be very useful. But this implies an extreme counterforce strategy on the part of the enemy which, as I have explained, will be highly unlikely in the future because it is ineffective against an invulnerable missile force. If the attack is exclusively by means of 100-megaton weapons exploded at high altitude then fallout shelters are totally useless because there will not be any fallout near the explosion. (There will only be worldwide fallout, months later, which is at a sufficiently low level so that shelter protection is unnecessary.) The reality, if war should come, will probably lie somewhere in between: there will be some fallout and fallout shelters will save many lives, especially in smaller cities and in the country. But fallout shelters will be useless in those big cities which will be actual targets. Further their value anywhere is diminished if there are repeated enemy strikes, which is likely if both sides have invulnerable forces. Thermonuclear war remains a terrible catastrophe no matter how extensive is a shelter program.

One objection to the shelter program is that its greatest effectiveness is in the framework of a counterforce strategy from which we are trying to get away, that it tends to make the American people accept thermonuclear war as a reality when we are trying hard to make such a war less and less likely. A shelter program is acceptable only as an insurance against the possibility that we may be unsuccessful, insurance which may or may not pay off. To avoid a nuclear holocaust must remain the main goal of our military policy and this end is served by the invulnerable deterrent force.

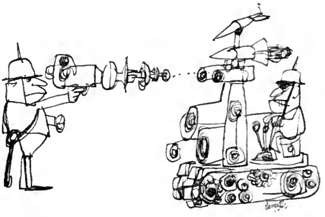
Some military experts have stated that the stable deterrent is likely to remain stable until one side or the other finds an effective civil defense or an antimissile

missile, so-called AICBM. I think it is clear that any really effective civil defense is impossible and I believe the same is true of AICBM. This is more difficult to prove, largely because much of the argument is classified. The difficulty is not the most obvious one, that it is difficult to hit a fast incoming missile by your own antimissile. This can be done; in face we have announced some successful tests of our antimissile, the Nike Zeus. There is also no problem about providing suitable atomic warheads for antimissiles, contrary to the claim of many opponents of the nuclear test ban. The offense has always many more possibilities than the defense. The offense can choose its target, it can concentrate a lot of fire on one target while the defense has to defend 20, 50, 100 different targets. The offense can always bring in enough missiles to use up all the defensive missiles which may exist near one target. The offense can fire a salvo of many missiles simultaneously which will saturate the radars. And most important, the offense can send, with the actual missiles, decoys, gadgets which look to the radars just like missiles. In spite of intensive work on this problem it remains extremely difficult to find any way to tell them apart. For these reasons I believe there is no effective AICBM system.

I have discussed how the stable deterrent decreases drastically the likelihood of thermonuclear war because a nation no longer needs to attempt to be the first to strike. This makes it possible for the nations to use restraint. It is no longer necessary to respond to confusing radar signals by launching missiles. Even an accidental attack by one enemy missile or bomber need no longer trigger a war, but can be answered by suitable diplomatic action. But the most important restraint can be used in war itself: It is no longer necessary to shoot off clouds of missiles for fear the enemy will otherwise destroy them, but it is possible to limit the number actually fired to that which appears necessary. Thus I believe that even if the deterrent should fail, a war in the era of invulnerable missiles need not lead to complete destruction. On the other hand, this means of course that such a war will not necessarily be over after one exchange of thermonuclear weapons, in contrast to the present belief associated with the counterforce concept. Each side is capable of destroying the other virtually completely, inflicting casualties which experts have put variously at 25, 50, or 90 per cent of the population, and even in the case of relatively moderate casualties, destroying the fabric of society and its institutions.

Once the deterrent force is essentially invulnerable it would even be possible to adopt some scheme such as that proposed by Leo Szilard in *The Voice of the Dolphins:* In case of a serious conflict between two countries, one of them may threaten to destroy just one city of the other to which the second may respond by a similar threat. Although the plan may seem strange at first sight, it would certainly mean a great reduction of the level of war from the present one, and it may not be unrealistic in the era of stable deterrent. It must be realized that war can be limited today only by an act of will on both sides. We must learn not to use our full strength. This is frustrating as will be well remembered from the Korean War, but it is the only way to avoid utter castastrophe. The destructiveness of modern weapons no longer permits unconditional surrender.

To use restraint after war breaks out, though militarily safe, may be psychologically almost impossible, even if the governments on both sides are entirely rational. An irrational government like that of Hitler may even launch an attack in spite of the invulnerable deterrent. In both these circumstances it would help greatly if the level of armaments were much lower than it is today. This could be done by gradual voluntary reductions on both sides. But it appears much safer to limit armaments by a treaty, strictly enforced by inspection.



- *THE TEST BAN*

Obviously the breakdown of the test ban negotiations is not a good omen for disarmament. After three years of negotiations, no treaty was concluded and the Russians resumed testing. However, we should not accuse the Russians of breaking an agreement by their resumption of tests. The moratorium was no agreement, but a voluntary undertaking on both sides. In fact the United States insisted repeatedly that the moratorium was temporary and could be terminated any day.

Nevertheless, I believe that the USSR showed bad faith. It is very likely that they had started specific preparations by March of 1961 when the test ban conference reconvened in Geneva. Therefore they negotiated for at least six months in bad faith. They did so just just at the time when we were showing most clearly by our concrete proposals at Geneva that we were sincerely interested in a test ban and willing to meet Soviet political demands on the control system more than half way. Moreover the kind of weapons tested show that their laboratories had probably been working full speed during the whole moratorium on the assumption that tests would at some time be resumed. Our laboratories put their main emphasis on such improvements as could be used and go into stockpiles without test. The very gradual start of our testing is the best proof that we had not anticipated resumption.

Many opponents of the test ban, impressed by the technical progress made by the Russians in their 1961 tests, argue that we should never have entered these negotiations. I would draw the opposite conclusion: It would have been a great advantage to us to conclude a test ban treaty at the earliest moment because it would have stabilized the technical advantages we had in 1958. If we had been less concerned about the perfection of the inspection system and about the possibility of the Russians' concealing some tests in the kiloton range, it might have been possible to conclude a treaty in 1959 and thus to prevent their very impressive multi-megaton tests of 1961. Of course, even if we had had less reservations on inspection, a treaty might not have been concluded. But if the Russians had continued to make difficulties in the face of a more yielding attitude on our part we might have known their real intentions earlier.

We do not need to look far afield for reasons why the Russians resumed testing. They knew as well as we did that they were technically behind in 1958. By testing in 1961 they were bound to approach our technology more closely even if—as they had to assume—we would answer by tests of our own. The laws of physics put a limit on the explosive yield which can be obtained from a given weight. Both the USSR and the U.S. are rapidly approaching this limit, therefore the country that is behind is bound to gain more than the more advanced country, no matter how hard the latter may try. There is thus no reason at all to assume that the Russians thought they could leapfrog over us by their test series; the expectation to approach us more closely was motive enough. There is even less reason to think that the Russians needed clandestine tests before their open ones in order to be sure that their megaton tests would actually work—it is perfectly straightforward to prepare megaton tests purely by theoretical calculations and to expect them to work; we have often done so in the past. Indeed, as far as I know there has not been any persuasive evidence, despite claims to the contrary, that the Russians conducted clandestine underground tests during the moratorium.

An interesting sidelight is the appraisal of the effectiveness of underground tests. During the negotiations the opponents of the test ban claimed that it was easy to carry out almost any test underground, and that underground testing would not appreciably slow down weapons development. Even to construct big "latter" holes in which explosions could be decoupled was supposed to be easy and quick, at least for the Russians. Now the same group tells us that underground tests are much too slow, that atmospheric tests are needed to make sufficiently rapid progress in our weapons development.

However, I do not want to pursue these technical problems because I believe it was a great mistake during the negotiations to concentrate so much on technical devices. Everybody, whether qualified or not, was discussing whether you could detect underground nuclear explosions and distinguish them from earthquakes. There was hardly any consideration in this country of the political implications and of the military advantages or disadvantages of a test ban. One of the best results of the negotiations on the test ban was that we recognized our deficiencies and that we set up the United States Arms Control and Disarmament Agency, an autonomous agency loosely affiliated with the State Department. This agency will deal with all the political, military and technical problems of disarmament. It is one of the most hopeful events in disarmament.

The test ban as an isolated issue, separate from a more comprehensive disarmament agreement, is in my opinion no longer a desirable goal to pursue. I had two main intentions when I advocated it: to stabilize the technical advantages in nuclear weapons which the United States had in 1958, and to obtain an inspection system which could be a precedent and an example for the inspection of future disarmament agreements. Neither of these aims can any longer be fulfilled. The Russians have largely caught up with our technology, and they now refuse to have any elaborate inspection system for such a limited objective as a test ban. Therefore I believe it was quite reasonable for the West, on reconvening in January 1962, to accept the Russian proposal of spring 1961 to merge the test ban negotiations with the more important negotiations on general disarmament. However the Russians no longer liked their own proposal and the negotiations were therefore broken off after 353 sessions.

On the other hand, in the heat of the battle, the value of nuclear tests has been greatly exaggerated. The art of nuclear weapons design is already well advanced. It is generally considered desirable to make weapons lighter for a given yield in order to facilitate their delivery; but only a rather modest decrease in weight is foreseeable. The laws of physics completely rule out a repetition of the development from the Hiroshima bomb to the present in which the energy yield increased by a factor of a thousand for about the same weight. Modest improvements are of course possible but they are certainly not a matter of life and death for the security of the United States. Improvements in the art and reliability of missiles seem to me of far greater military importance.

Nevertheless, in the absence of a test ban agreement, and after the extensive Russian test series in which they attempted to catch up to our technology, it would seem reasonable that we develop nuclear weapons along with other military technology—neither neglecting nor frantically overemphasizing them. In particular we should test those designs which fit into our strategic plans and have been developed theoretically in the laboratory, in order to be sure that we can rely on our designs and thus on our invulnerable deterrent. There are some weapons effects tests which we might profitably make. But I do not believe that nuclear testing is the endless frontier that some people seem to see in it.

- *ARMS REDUCTION*

If the test ban is no longer a desirable field for disarmament then what is? One area which has been discussed is a cut-off of production of fissile material and a reduction of the nuclear weapon stockpile. A cut-off of production is attractive because it would be rather easy to inspect at the production plants but it is not very effective because the United States and the USSR have enough fissile material to supply a huge strategic force and more. A reduction of the stockpile of nuclear weapons which might be an effective disarmament measure would be more difficult to inspect because nuclear weapons are rather small, they can be stored almost anywhere and are hard to find even if one has complete access to a country. The best way to monitor such a reduction would probably be to inspect the records of past production in each country and try to trace the material which has been produced.

To my mind the most promising and the most important area in which to start disarmament is that of strategic delivery vehicles, as proposed by de Gaulle a few years ago. Atomic weapons don't mean much unless they can be delivered to the enemy country. Because of their size large bomber plans and long range missiles are easy to find once you have some access to a country, in contrast to the small and hard-to-find atomic weapons. As I explained earlier, in the era of invulnerable deterrent it is no longer necessary to have large numbers of such strategic delivery vehicles. At present we have about 500 B-52s and 1000 B-47s, in a few years we are likely to have also about a thousand invulnerable long range missiles. It seems to me entirely safe to reduce this varied force to a few hundred missiles, once they are invulnerable, each carrying perhaps one megaton, in contrast to the 10 or 20 megatons now carried by our planes. This would be an enormous reduction of the total destructive force. It may be useful in this connection to remember that all the bombing raids on Germany in World War II together added up to one megaton. But this drastic reduction will only be possible if we can be sure that the other side has made a similar reduction.

This brings us to the all-important problem of disarmament, that of inspection. In September of last year in a very important document, John McCloy, the disarmament adviser to President Kennedy, and Mr. Zorin of the Soviet Union agreed on some principles of disarmament. Among them, specifically and explicitly, was that any disarmament treaty should include inspection. Though the two sides did not agree on the kind of inspection, the inclusion of the word in the agreement offers hope and it is most remarkable and encouraging that this agreement could be concluded in the midst of an intensified phase of the cold war. The Russian offer so far has been to let us witness the destruction of whatever missiles or planes they may in the future agree to destroy. Unfortunately this is not of great interest to us. We must rather know and inspect the armaments remaining to them. With their type of inspection we could not guard against new weapons production nor against a false declaration of their initial armaments.

Our type of inspection becomes increasingly important the farther disarmament progresses. Assume, for example, that a country has initially 50 per cent more armaments than it declares. This does not make too much difference. But when half of their initially declared armaments have been destroyed then they would actually have twice as much as declared, and when their armaments have been supposedly reduced to one-quarter of the present amount, they would have three times what they are supposed to have. Inspection of production facilities would help on the problem of building new armaments, but again there is the problem of completeness of information.

We must admit that the Russians also have good reasons for their point of view. As long as most of their delivery vehicles are soft, as long as they rely on long range planes, and on missiles which are above ground, we could destroy these by our surprise attack, and I believe that the Russians are as afraid of our surprise attack as we are of theirs. Indeed, the United States Air Force has espoused the principle of counterforce strategy for so many years that the Russians have every reason to be afraid of letting us know the location of their forces. It is true that new counterforce strategy seems to be getting less popular in the Defense Department, but how can the Russians feel sure that we have given it up? In this situation they naturally wish to preserve one of their greatest military assets, the secrecy of the location of most of their striking force.

Thus we have an impasse: We need to know how many delivery vehicles the Russians have, i.e., we need to inspect, while the Russians need their secrecy, at least until they have constructed a completely hardened force of missiles. The best way out of this impasse has been suggested by Professor Louis Sohn of the Harvard Law School. He suggests inspection by an ingenious sampling procedure: Each of the two countries, Russia and the United States, makes a map of its own territory, dividing it into a number of areas, let us say 20. Each country chooses the location and shape of these areas to its own liking but in such a manner that they have approximately the same military importance or value. Then the maps are exchanged. At the same time each country declares the total number of its missiles and airplanes, its important military production facilities, etc., and also the number of each category located in each of the 20 areas. Now Country B having received all the information from Country A will choose an area to be inspected, for example, Area No. 17. Then Country B has the right to inspect Area 17 of Country A in all detail, using planes, automobiles, going into factories, and so on, with limitations as stipulated in the treaty. Country A similarly makes an arbitrary choice in Country B and inspects that area.

What does this accomplish? It means that only five per cent of the country is open to inspection to begin with, leaving the Russians their cherished secrecy for still 95 per cent of their country and hence presumably 95 per cent of their strategic force, since they presumably will have divided the country into strategically about equal areas. At the same time we can verify the initial Russian declaration of existing armaments in Area 17 in every detail. It would clearly be extremely dangerous to cheat in the initial declaration, certainly in any major way, because there is always some intelligence information which would tell Country B if some area of Country A has an excessive force of missiles, and Country B would be sure to choose just that area for inspection. Hence gross inaccuracies in the initial declaration are clearly against the interest of each country, while minor inaccuracies would not disturb the strategic balance. The important point of the Sohn plan is that it checks the accuracy of the initial declaration, and hence establishes that trust between the nations which is so lacking today, and so important for disarmament.

In addition to the method of inspection, a disarmament agreement must of course specify the schedule of arms reduction. Let us assume strategic armaments are to be reduced by 10 per cent every half year, this to be repeated nine times until only 10 per cent of the initial armaments remain. Every half year, a new declaration of total armaments would have to be made, both by Russia and the United States, which must show at least 10 per cent less total force than the previous one. Also every half year another area is picked for inspection by choice of the other country, and again it can be verified that in that particular area the number of delivery vehicles has actually been reduced to the number in the new declaration. The first area presumably remains subject to inspection but this could be arranged differently by agreement.

So far, I have considered the Sohn plan as it applies to the United States and Russia, and to a reduction in the number of strategic delivery vehicles. But of course disarmament must extend to other countries, to the Warsaw and Nato Pact, to the People's Republic of China and finally to all countries of the world. Disarmament must also be extended to other weapons categories, to naval vessels, to fighter planes, to tactical nuclear weapons, to tanks, guns and standing armies, and so on. It is of course important to find out whether such a plan would be acceptable to the countries concerned.

It seems to me important that disarmament, whether along this plan or any other, should not interfere with the establishment of invulnerable forces, both by us and by the Russians. Since these forces are only now being built up, this means that presumably the number of weapons in certain categories must initially be increased while others are being reduced. Thus the agreement should be sufficiently flexible and must not, for example, call for the same percentage reduction in each category. On the other hand it seems to me essential that negotiations for arms reduction begin now when the stable deterrent is in sight. At this point, both sides have reason to feel secure and strong, so that negotiation is from strength on both sides. Postponement to the time when stable deterrent forces are fully developed is unnecessary if the treaty permits such development. At the same time, any postponement is dangerous because new factors may upset the balance, either technological changes or increased power of additional nations. If an understanding between East and West has been reached by that time, such an upset is much less likely to occur.

A drastic reduction of strategic forces by treaty with inspection as suggested by Louis Sohn seems our best hope of stopping the arms race. To start on this road both sides will have to change some of their attitudes. The United States will need to renounce that policy of massive retaliation which involves applying a strategic threat against peripheral war. To make this possible without yielding to the Communists it will be necessary initially to build up our conventional forces, in line with President Kennedy's idea that we must have a third alternative to nuclear holocaust or surrender. A temporary build-up of our conventional military forces is an essential counterpart to nuclear disarmament. Our young men as well as those of Western Europe must be willing to serve in the Army and must understand that this actually decreases the risk of all-out thermonuclear war. For some time to come we may need to retain tactical nuclear weapons for use in limited wars, even though the experts disagree strongly about their usefulness and on whether they favor the offense or the defense. In any case I believe the important distinction is between strategic war with long-range missiles and tactical war in the vicinity of the battlefield, rather than between nuclear and non-nuclear war. I hope the invulnerable deterrent will be effective enough so that even if nuclear weapons were used on the battlefield the war would not escalate into a full-scale strategic nuclear war. When the strategic threat is thus reduced, I expect that the ground forces will gain in morale, since this will greatly raise their importance in our military establishment. Ultimately I would hope we can eliminate nuclear weapons both from tactical and strategic forces.

These are some of the things we must do. The Russians on the other hand will have to open their country to inspection by a disarmament authority, perhaps on the Sohn territorial plan. They will also have to realize that their professed goal of complete and general disarmament can only be reached by means of limited, meaningful steps. Finally they will need to give up hopes, if they have them, of achieving ultimate military superiority which though far in the future, they might achieve in a continued arms race if some unforeseen technological breakthrough were to disturb the invulnerability of our missile force.

• *COMPLETE AND GENERAL DISARMAMENT*

In the McCloy-Zorin Agreement of September 1961, both Russia and the United States agreed to work toward general and complete disarmament, thus accepting the proposal which Khrushchev made to the United Nations in the fall of 1960. Both sides also agreed that this goal can only be achieved in steps, and that no step must put either side at a military disadvantage. There are several other equally reasonable provisions in the agreement.

We must therefore examine what we have to expect of a world in which disarmament is general and complete. First of all, in order to achieve such a disarmed world, we must find ways to settle disputes by other means than war. For this, we must strengthen world law and submit international disputes for final arbitration to the International Court in the Hague. The U.S. does not have a good record in this respect: it is urgent that our Senate repeal the Connelly Amendment which provides that the United States will be bound by decisions of the Hague Court only if it so chooses. Naturally the Soviet Union also would have to recognize the Court. The recognition of world law would clearly weaken national sovereignty which at present runs counter to the avowed beliefs of the Soviet Union. To enforce world law we shall probably need an international police force stronger than the armed forces of any particular country or of any likely alliance. The important question will be: Who controls the international police force? It might indeed be very dangerous if this force were a power of its own, as the Pretorian Guard was in ancient Rome.

These are just a very few of the many problems which must be solved before disarmament can be general and complete. I do not profess to know the solutions. It is clear to me that it will be difficult to get agreement between the United States and the Soviet Union on these problems, and on the organization of a completely disarmed world. Obviously we can not wait for agreement on all these matters before stopping the arms race. It is important to make a beginning, and to reduce armaments even if we can not yet eliminate them completely. I believe there are ways to do this which will not endanger but rather increase the security of the United States.

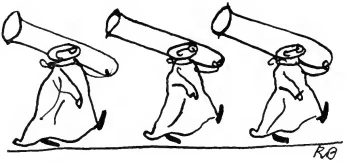
Responding to Disarmament Violations

ROGER FISHER

It may clarify this article to indicate at the outset some of the topics that it is not about. Disarmament problems can be divided into three broad categories. One is that of devising appropriate rules of conduct relating to arms. A second, perhaps the most critical category, relates to the process by which disarmament rules should be established, such as formal treaty or unilateral restraint. The third broad category of disarmament problems, and the only one considered here, is that of securing compliance with disarmament rules after those rules have been established.

Here confusion has been caused through the use of the word "control." Sometimes control is used in the sense of inspection. This is sound historically, for the word used to mean to verify by checking against a duplicate register or roll. But on other occasions we use the word control in the sense of effective power, as when we say that a forest fire has been brought under control. When the United States speaks of disarmament under effective international control there is a danger that the two concepts have become confused. Factual inspection—even 100 per cent inspection—does not automatically lead to compliance. For example, last year the United States had adequate inspection to determine atmospheric violations of the moratorium on nuclear testing, yet the Soviet Union ended the moratorium and resumed atmospheric testing. Inspection is not effective control.

Inspection serves two purposes. If there is compliance, inspection serves to reassure others of that fact. Inspection also plays a part in causing compliance. Many of the forces on which we must rely to cause compliance depend for their effectiveness on someone's knowledge of the facts. For these forces to be effective inspection may be a necessary though not a sufficient condition.



We may seek to cause governments to comply with disarmament rules in a number of different ways, many of which can be combined. Each government might agree to incorporate the disarmament rules into the fabric of its own domestic law and enforce the rules against itself as it does the provisions of its own constitution or other fundamental law. We might be able to arrange matters so that any official who tried to violate the disarmament rules would run the risk of paying a high political price within his own country for doing so, or might damage himself or his country in the eyes of groups abroad that were important to him. Rather than analyze these and other techniques for encouraging compliance, this article is limited to the problem that arises after the fact of noncompliance—the possible responses to an actual, apparent, or possible violation of a disarmament rule. It may be considered as one approach toward an answer to Fred Ikle's famous question in *Foreign Affairs* of January 1961, "After detection—What?"

In considering the response to a violation it must be remembered that we would prefer not to have the violation at all. Compliance should not be thought of solely in terms of what happens after a violation has been detected. To do so is like thinking of the problem of keeping a horse in a barn in terms of the question: After the horse has escaped what shall we do? But that question is nonetheless a meaningful one, for the anticipated response may persuade the horse not to escape. And if despite our best efforts he escapes, then what do we do? Some actions are better than others: It is better to lead the horse back into the barn than to shoot him.

• *RULES ABOUT BREAKING RULES*

The problem of responding to an apparent or possible violation of a disarmament or arms control rule is not simply one of planning a response. It is one of creating rules about responses—rules about what happens when rules get broken. We would like to arrange the international legal order in such a way that one breach of a disarmament rule does not knock down the whole structure. We would like a broad conception of the international law of disarmament, one which covers not only primary rules of what governments should and should not do with respect to arms but also encompasses secondary rules about what governments should and should not do if one government fails to respect the first set of rules.

Disarmament itself can be viewed as a precautionary rule. The real evil lies in the use of arms, not in their possession. As is the case with narcotics or switch-blade knives, we create a precautionary rule against their possession to lessen the chance of their being used improperly. One of the virtues of this technique is that a breach of a precautionary rule does not necessarily cause any real injury whatever to society. By establishing and enforcing a rule against carrying switch-blade knives we may be able to act before anyone is hurt even if a knife is sometimes carried. It makes it possible for society to deal with a small and in fact harmless violation as a small problem before it becomes a big one. But if we are to get the full benefits of this precautionary rule system—the benefits of disarmament—we must develop limiting standards which enable us to keep small problems small. We must be able to respond to violation of a disarmament agreement within a framework of continuing rules that avoids turning the response into an overall contest of will between one government and another.

Over the years we also have discovered in domestic law that it is not wise to respond to a violation by treating the guilty party as being beyond the law. The man found carrying a switch-blade knife is not treated as an outlaw. The abandonment of the concept of outlawry in domestic law suggests the direction in which we should proceed internationally. Concepts of self-help, self-defense, and the posse may be preserved, but our efforts should be to regularize them and govern them by law. A breach of a disarmament treaty must not be thought of as terminating the legal relationship but rather as an act which produces certain legal consequences.

A response to a disarmament violation has, by definition, already failed as a deterrent to that violation. Nonetheless, one of its functions is to serve as a warning or threat designed to discourage subsequent violations of this rule or others. Another purpose of responding should be to nip a violation in the bud, to make the most of the fact that disarmament rules are precautionary rules and seek to deal with the situation created by the actual or possible violation before any real harm is done. If it is too late to do this, a response should serve to redress any imbalance or instability created by the violation. It may also serve the cause of international order by giving the party who feels aggrieved by the violation a chance to let off steam.

A wise and well-designed response should fulfill these purposes. At the same time it should do so without creating an undue risk that the original violator will engage in a counter-response which would increase the size of the problem and be disruptive of the international situation. The problem of defining appropriate responses is not unlike the problem of defining appropriate limits to a limited war.

A basic difficulty in generalizing about the problem of responses to a breach of a disarmament agreement is the wide range of possible circumstances. One might, for example, be thinking of the world as being only slightly changed from the way it is now. In the next year or so various arms restraints might be adopted such as ones against nuclear testing, against the production of nuclear material, barring the deployment of submarines in certain waters, barring nuclear weapons or airplanes from designated areas, or permitting advance inspection of satellite launchings. If there should be a clear-cut violation of a rule, what kind of response should be made? Alternatively, one may consider more comprehensive international measures and the kind of machinery necessary to deal with ambiguous situations. What kind of responses should be contemplated under extensive international arms limitation schemes? Although there are a host of intermediate possibilities, these two will serve as a basis for some preliminary thinking on the problem.

• *THE COMMON LAW OF APPROPRIATE RESPONSES*

Lacking an agreed set of rules on the subject, the current situation may be said to be governed by the common law of appropriate responses. Although modest and specific arms control measures might include express provisions about responses to violations, even they should be considered in the light of some general principles that usually go unstated.

Reciprocal noncompliance. The most frequently considered sanction for one country's failure to comply with an arms limitation is reciprocal noncompliance by others. Such a response may not fulfill the function of a deterrent to future violations for it allows one party to terminate a rule whenever it wishes to do so. Also, it is hardly conducive to international order to leave the community with one less rule than it had. The action is not one which tries to deal with the specific situation created by the violation before real injury takes place. On the contrary, one dangerous situation is met by creating what may be another.

Reciprocal noncompliance, however, is likely to satisfy both the original violator and the community in general as being fair. If the situation is truly reciprocal and recognized as such by all concerned, there will be little risk of escalating responses. But in the real world the response cannot be identical in all respects to the violation and there will be a risk of escalation. As the Soviet Union seeks to respond to Western military build-up by conducting the same number of nuclear tests as has the West (or by conducting the last nuclear test series, since the United States conducted the first), the West in turn seeks to respond by conducting the same megatonnage of tests or the same kind of tests, only to be followed by further responsive action by the Soviet Union. Particularly in the case of arms limitations, reciprocal noncompliance is likely to be damaging to the chances of preserving the general scheme. Attempts to negotiate equivalent arms limitations demonstrate the difficulty, if not impossibility, of reaching agreement on how much military equipment of one kind in one country is equal to a specified amount of military equipment of another kind in another country.

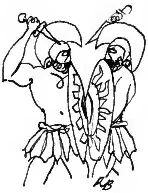
Noncompliance can be justified as being reciprocal either because the responsive action is the physical equivalent of the violation or because the responsive action is in derogation of the same rule that was violated. There is scope for ingenuity here in defining how much of a rule was broken and how much should be treated as no longer in effect. Domestic experience with the partial rescission of contracts and with the partial unconstitutionality of statutes suggest the kinds of arguments and considerations that come into play.

One particular point should be noted. The fact that a violation of one part of an agreement may be used to justify another country's repudiating the entire agreement argues for bringing about disarmament through a host of separate agreements rather than through one comprehensive treaty. For example, an agreement never to use nuclear weapons except as a reprisal for their prior use by another country should probably constitute a separate agreement not involving any other arms restriction. To include other provisions would run the risk that violation of one of them would justify abrogation of the no-first-use pledge—a pledge which has particular importance when other rules have been violated.

The legitimacy of reciprocal noncompliance also suggests that ambiguous restrictions should not be included in agreements which contain clearly defined ones. To include a promise against preparing for nuclear tests in a treaty against nuclear testing would tend to weaken the treaty. Because of the vagueness of the concept of preparing for tests and the technological research which would necessarily continue, either side could plausibly argue that the other side had broken the treaty by preparing to test, thus justifying a general repudiation of the treaty. Without such a vague restriction it would be more difficult to justify a repudiation of a test ban treaty.

Responses directed at the noncomplying object. The more directly that a response deals with the symptom of noncompliance the more acceptable it will be and the less danger it will create of escalating responses. At the same time, by dealing directly with the visible and tangible consequences of noncompliance it may be possible both to discourage future violations and to arrest this violation before real injury takes place. Directing a response at an inanimate object rather than at the person or persons who have been breaking the rule may seem irrational but is consistent with an intuitive sense of fairness that is reflected in many provisions of law, both domestic and international.

Under English common law, an object that caused a person's death was a "deodand" that was forfeited to the crown. Today, weapons used in the commission of a crime are similarly forfeited. Weapons illegally carried are confiscated, as are narcotics, bootlegged whiskey and goods smuggled through customs. Automobiles used to transport illegal liquor are subject to confiscation. The size of the penalty thus imposed may bear little relationship to the moral culpability involved or to the seriousness of the offense but there is nonetheless a crude and elemental justice about it. In the international field, similar sanctions are recognized in the laws of contraband and prize, and such seizures—unlike those in the domestic situation—are usually the only punishment imposed.



This suggests that in articulating the rules about appropriate responses to violations of an arms limitation agreement we would do well to explore what might be done by dealing directly with the objects involved in the particular violation. If we have a rule limiting the deployment of submarines, perhaps submarines that have gone beyond their limits should be deemed subject to being sunk on sight. Military equipment or weapons located in neutral territory in violation of a disengagement agreement might be considered contraband, subject to lawful destruction by any government (which should presumably use no more force than reasonably necessary). Weapons produced in violation of an arms limitation might similarly be subject to destruction upon being discovered.

Such limited responses directed at the illegal objects might not lead to escalation even if they involved military bombing. As in the case with espionage where a spy is subject to execution, it might be understood that responsive action may be more severe than the initial violation and that such responsive action does not justify counter-responsive action. The more narrowly that the responsive action is directed at the offending objects and at preventing their being improperly used the more justified it appears.

Responses agreed to in advance. A third element underlying the general concept of an appropriate response may be that of agreement or estoppel. If a government has agreed what should happen in the event of a breach, it has thereby weakened any basis it may have had for complaining or counter-responding if that particular response is imposed. But as our domestic law so clearly shows, an agreed penalty may nevertheless be considered by the community to be an unfair penalty which should not be imposed. And governments, subject to constant changes in personnel, can far more easily undercut the appropriateness of responses resting solely upon the agreement of prior officials than they can undercut one which rests upon general notions of fairness.

An agreement, however, which builds upon implicit notions of fairness can define and make legitimate responsive action which would otherwise be deemed less appropriate. In the disarmament field it should be possible to devise "liquidated damages" provisions which, by authorizing a particular response in the case of violation, would both make the response more certain and lessen the risk of escalation. It has been suggested, for example, that the Soviet Union and the United States might each deposit in some neutral country nuclear material, specified amounts of which would be forfeited to the other in the event of a violation. Perhaps means could be devised by which military secrets could similarly be placed in escrow. Our existing foreign bases in Turkey or elsewhere might be pledged as security for our undertakings, it being explicitly agreed that in event of a violation we would have to withdraw the base or it could be destroyed legitimately. It might be agreed that any satellite that was launched without prior inspection was subject to legitimate destruction by the other side; with some technological development, such destruction would appear feasible. It might be provided that if certain violations of an arms control agreement should occur, the other side would be allowed to conduct increased airborne inspection. (Such inspection planes might be allowed to carry some kinds of weapons which they would be authorized to use if they were attacked.)

By providing agreed rules as to what happens in the event of a breach of the rules the essential talent of the law to deal with disorder in an orderly fashion is brought to bear. That such techniques might work even in a world without an effective international organization is suggested by the case of espionage. Learned disagreement as to whether or not it is a violation of the law of nations for one government to use spies against another tends to conceal the significance of the fact that in this area there has developed international law as to what happens when one government does deliberately break the laws of another. The aggrieved government does not proceed against the offending government but against the individual spy; it gives him a trial and may punish him with death. This agreed rule about what happens when the rules get broken lessens the risk of escalating responses and counter-responses, and provides significant aspects of order even in a world unaffected in this regard by international institutions.

• *RESPONSES TO COMPREHENSIVE AGREEMENTS*

Agreements which included provisions as to what should happen if there was a breach of an agreement would constitute a significant change from present conditions. It may be worth while to try to generalize about the problem under what is assumed to be some reasonably comprehensive arrangement such as might be involved in the intermediate or later stages of a disarmament process.

Grenville Clark and Louis Sohn, in their crusading book, *World Peace Through World Law* (published by Harvard University Press, second edition, 1960), have charted much of the way. Their proposals wisely emphasize the importance of procedure. Under their suggested scheme it is always clear who is to determine what, and which decisions are to be final. Their book is full of suggested rules about what happens when rules get broken. In fact, the premises of the Clark and Sohn enforcement provisions seem so sound that my criticism of them is primarily that they do not go far enough. A preliminary examination of such responses suggests three propositions which might be taken into account in trying to improve upon the Clark and Sohn proposals.

Governments should not be treated as criminals. When one contrasts discussion of governmental breaches of a treaty with discussion of governmental breaches of the Constitution the difference in vocabulary used is striking. In the international context we tend to use words that carry a criminal law connotation. The question is usually stated in terms of sanctions to be imposed for a violation. Within this country, the problem of what to do when a state government is behaving in an unconstitutional fashion is not conceived of in those terms. When it becomes clear that Louisiana has adopted a statute which violates the Constitution, the issue is not formulated in terms of what sanctions should be imposed upon Louisiana or how that state should be punished. Again, when the federal government adopts an unconstitutional statute which, for example, abridges the freedom of speech, no one suggests imposing a sanction on the government for its misbehavior. It would not be impossible to design sanctions such as an automatic payment which the federal government would have to make to all the state government if it violated the Constitution or which a state that had broken the Constitution might have to pay to the federal government. Conceivably, such sanctions might work. But domestically no government is ever treated as a criminal against whom a sanction is to be imposed for misconduct.

For in the case of a government, the people who made the decision in question and the nation against which a punishment be imposed are necessarily different. To the extent that punishment is designed to act as a deterrent to future violations it should be directed at the individual who will in fact be deciding the government's conduct. If we are to deter Congress from adopting unconstitutional legislation it will do little or no good to fine the United States—a fine which would presumably result in less funds for the defense department or an unbalanced budget. We might, of course, treat as criminal the conduct of the individual congressmen who voted for the bill and impose an automatic salary cut of, say, ten per cent for every unconstitutional statute adopted. But for good reasons, relating to the independence we would like our representatives to feel, we have not done so. Our successful experiences in maintaining respect for the Constitution suggests that we should not conceive of the problem of enforcing rules against governments as one of imposing punishment after the fact.

Violations should be considered as disputes. Looking at examples of governmental behavior contrary to domestic statutory or constitutional law, one notes that throughout the period of the violation the government was insisting that it was behaving properly. This suggests an aspect of government behavior which may provide a useful handle for working on the compliance problem. Governments apparently feel compelled to justify what they do in terms of principle. Governments may dispute the facts, they may dispute the application of the rule to the facts, or they may contend that a different or higher rule governs the particular situation, but a government will not admit that it is currently breaking the applicable rules without justification.

To be sure, a government may admit that it has broken a rule in the past but that it is not now doing so. For example, a government might admit that it launched a test missile or conducted a prohibited overflight in violation of a disarmament treaty, but say that this had been ill-advised or unauthorized and would not happen again. And the same thing might happen again and perhaps again. In such cases there may truly be said to have been violations rather than disputes. Any comprehensive arrangement should include rules about what should be done in the event that the rules have been violated. As discussed above, the response provided for would presumably be one that undid as much of the damage as possible (such as turning over the data developed by an illegal test), or involved a forfeiture of sufficient magnitude to keep high the deterrent against a repetition of the offense, or both. If the government acquiesced in the response, the violation would be closed. If not, the government would no doubt advance some justification and the community would again be confronted not with a past violation but with an ongoing dispute.

One problem is thus to devise appropriate corrective action for the government which is prepared to accept it and to operate on the fact that it erred in the past. But the major problem would appear to be to construct means for dealing with disputes. Although past conduct may be the immediate cause of a dispute the meaningful difference is necessarily over the future—over what the government should be doing starting right now. An alleged breach of a disarmament rule gives whatever international machinery is established under the disarmament arrangement a chance to move in and deal with the problem before something really serious happens. Whatever evidence of past conduct is available, the problem is most usefully thought of as an international dispute over future conduct.

It may be possible to have judicial decisions without compliance, but it is impossible to have a pattern of compliance without judicial decisions or some comparable method of settling disputes. For the compliance we want to achieve is not merely compliance with the obvious central meaning of a rule of international law. We want compliance with the rule right out to its edge, where reasonable men can differ and governments are even more likely to do so. In this area compliance is desired, for without it one government will believe and say that another government has violated the rule. Such beliefs and such charges will undercut the force of the rule and erode the willingness of governments to respect it, even if the disputed instances do not in themselves constitute important threats to national security. In this borderline area, where a rule of international law is unclear and can reasonably be interpreted in different ways, the very concept of compliance depends upon there being a court or some other authoritative way of determining what the rule is. Under any comprehensive disarmament scheme there must be, as Clark and Sohn emphasize, judicial machinery competent to decide all questions of interpretation and obligation. Not only should the jurisdiction be broad, but the court should have the jurisdiction to decide the extent of its jurisdiction.

As suggested above, countries feel compelled to justify their conduct. The enforcement process can be looked upon as a steady whittling away of the grounds for noncompliance. Once a court has interpreted the basic obligation, it should continue to have jurisdiction to hear, consider, and in its judgment reject, reasons advanced for not doing what the court has indicated should be done. The case of Dollar versus Sawyer (in the U.S. District of Columbia Court of Appeals in 1951) is instructive. When Secretary of Commerce Sawyer was ordered by the court to turn over certain shares of stock to the plaintiff, he declined on the ground that the President had ordered him not to do so. The court heard this argument and rejected it. Other grounds for not complying with the court's decision were all heard by the court and found to be without merit. The administration found it increasingly difficult to justify noncompliance on any ground and finally settled the case.

For an international organization to consider a situation in terms of a dispute over what should happen in the future rather than what has happened in the past is to keep its attention on the more important problem. There is no indication that governments benefit from being chastised or blamed for misconduct in the past. The recent Security Council resolution condemning Israel, no matter how well deserved, is not likely to improve the situation. On the other hand, the more serious the situation the more vital is the question, what do we do now? How should we mop up the spilled milk?

Judicial orders should seek to restrain individuals. Whether or not action of an officer which is found to be contrary to a disarmament obligation has been officially and formally endorsed by the government, there are great advantages in a court's directing its decree at the individual. Most governments find it more acceptable to allow an officer to be enjoined than to have a court order enjoining the whole government as such. To some extent it saves face, and, being a civil action, carries less stigma than a criminal case. And it makes compliance easier since it is easier both for the government and for the officer to accept a directive for the future than to be called a criminal.

Most significant, however, is the fact that directing a judicial order at a designated individual passes the problem of the response back to his government. Hopefully, the order can be phrased negatively, ordering the officer to refrain from certain conduct. Inaction is comparatively easy and if the officer faces a chance of being confined for contempt, he will probably wait. His government is now faced with the difficult question of what to do. The international authority has taken minimal action, simply ordering the responsible officer to refrain from doing something. Any governmental action to the contrary will presumably require a collective decision. As excuses for noncompliance get whittled away through the judicial process, the government's choice is between going along with the decision and letting the officer comply or raising the ante through a total confrontation with the international scheme. The shoe is now on the other foot. Where there is international judicial machinery, the government must either go along with the court's decision ordering an officer to refrain from specified improper conduct or take upon itself the responsibility for the disruptive response of throwing away the entire agreement. The more narrowly drafted is the judicial order the smaller will be the disadvantages of complying, and the more likely they are to be outweighed by the disadvantages of direct confrontation with the international organization. On the other hand, where there is no international judicial machinery, a "good" government has to decide whether a small violation by a "bad" government justifies the disruptive response of throwing away the entire disarmament agreement.

• *STRUCTURING THE RESPONSE*

The problem of response to an apparent or possible violation of a disarmament agreement can thus be considered as devising means of passing the problem back to the other side. If the immediate response is authorized by established rules, is narrowly directed at the particular phenomenon in question, is designed to prevent future injury, and is ordered by a competent court that has heard and rejected all arguments to the contrary, the response will be almost automatic and will strike the community as fair. The question of what to do next will have been given to the government which caused the original problem. It will have the choice of going along with a small bit of compliance or engaging in major defiance. Just as there is no way of guaranteeing 100 per cent compliance with the original disarmament rules there is no way of guaranteeing 100 per cent acceptance of the authorized response to a breach of those rules. But we can hope that by legal and institutional techniques we will be able to structure the situation so that the questions come up in such small bites that the large interest each country has in maintaining some scheme of international order outweighs the small gain that would be accomplished through defiance in a particular case.

Arthur Holly Compton

ALEXANDER LANGSDORF, Jr.

Arthur Holly Compton, who died on March 15 of this year, was a distinguished scientist who, in 1923, discovered that the wavelength of x-rays changes when they are elastically scattered by electrons, a phenomenon generally known as the Compton effect. This discovery was soon recognized to be one of the fundamental experimental links in a series of steps leading to the establishment of the quantum theory; for it he shared a Nobel Prize in physics in 1927. He made other valuable contributions in the study of x-rays during this period. In the 1930's he turned to the study of cosmic rays, in which he became a leader, and established the particulate nature of the primary cosmic rays which reach the earth from outer space. In so doing, he won a notable dispute with Robert A. Millikan, who championed the view that cosmic rays are an electromagnetic radiation like light and x-rays, although much more energetic.

• *THE SCIENTIST*

Arthur Compton was honored repeatedly for his contributions in science and for his many other services to society; he received some 25 honorary degrees from universities and colleges, and 20 medals and prizes from various scientific societies and governments. He was an honored or honorary member of about forty scientific academies or societies all over the world. Among the small number of scientists of special renown, he had an almost unique combination of additional blessings. His voice was mellifluous, his personality felicitous, and his appearance remarkably handsome and distinguished. In addition, as has often been pointed out, it was his good fortune to come from a family similarly gifted. His eldest brother, Karl Taylor

Compton, was also an eminent physicist and administrator, who was president of Massachusetts Institute of Technology for many years. His brother Wilson, now retired, was president of Washington State College. His father was Dean of the College of Wooster in Ohio, where Arthur Compton was born in 1892 and went to college, graduating in 1913.

After he received his PhD in physics from Princeton University in 1916, Compton continued research at the University of Minnesota and at the Cavendish Laboratory at the University of Cambridge, England, where he was fellow of the National Research Council. His professional life thereafter was essentially divided between the University of Chicago and Washington University in St. Louis. At the latter institution he was professor and head of the physics department from 1920 to 1923, chancellor from 1945 to 1953, and distinguished service professor of natural philosophy thereafter until last year, when he became professor-at-large for Washington University, the University of California at Berkeley, and the College of Wooster. From 1923 to 1945 he was at the University of Chicago as professor of physics and, from 1940 to 1945, head of the physics department and dean of the division of physical sciences.

• *THE ADMINISTRATOR*

Arthur Compton had very strong feelings of responsibility and sense of duty. He was one of the original members of the Board of Sponsors of the *Bulletin of the Atomic Scientists*, and accepted positions as advisor or trustee on many boards, too numerous to recount here, as well as undertaking administrative positions, including the presidency of the American Physical Society (1934) and the American Association for the Advancement of Science (1942). He was active in the work of the National Academy of Science, most notably as chairman of the committee which looked into the prospects for atomic weapons in 1941. Subsequently his heaviest responsibility was as director of the plutonium bomb project of the Manhattan District centered at the University of Chicago from 1942 to 1945. He recorded a great deal of the information about this period of his life in his book, *Atomic Quest, A Personal Narrative*, published in 1956.

A most vital function fulfilled by Compton in the development of the atomic bomb was serving as a link between the group of brilliant scientists essential to that undertaking and those in the government, military, and industry, who had the authority to carry through the gigantic effort. His character, prestige, and background were such that he could successfully assure those in authority of the validity of the work and predictions of the scientists. Extraordinarily few of the scientists could inspire this confidence for various reasons, including youth, personality, foreign birth, and even enemy-alien status.

In chapter four of *Atomic Quest*, Compton discussed the fateful decision on how to use the atomic bomb against Japan. He described the variation of opinion among scientists in the project who were disturbed in regard to this decision, and explained his own reasons for agreeing with the decision made by President Truman, to whom he was a key scientific advisor. (A complementary account of the similar variation of opinion among some responsible governmental and military officers is presented in chapter six of *No High Ground*, by Knebel and Bailey, published in 1960.)

• *THE CITIZEN*

Professor Compton frequently lectured, not only on topics in science but also on religion, philosophy, and human welfare, all fields in which he had deep interests and strong feelings. He held many visiting lectureships and professorships at institutions over the world. These, together with his worldwide studies of cosmic rays in the 1930's, gave him and his wife, Betty, extensive opportunities to indulge their taste for travel. His wife not only usually traveled with him, but shared all his thoughts and activities to such an unusual degree that (as he described in *Atomic Quest*) he insisted she also be cleared with him for his secret work on the atomic project.

Despite his hope that cultivation of an attitude of brotherhood among men could insure lasting peace, he sometimes expressed a lack of confidence that human society could long endure. But he thought that we have no course other than to continue the search for knowledge, to try to use this knowledge wisely, and to hope that we make no crucial mistakes which would stop the human adventure.

Arthur Compton was a cordial and considerate person, genuinely interested in other people, who was always faithful to the ideals of service to mankind which were a strong tradition of his family and of Wooster College. His death is a great loss not only to his family but to the community of scientists and the many others throughout the world who knew and admired him.

BOOK REVIEWS

CONFLICT AND DEFENSE

Conflict and Defense; A General Theory. By KENNETH E. BOULDING. New York: Harper & Brothers, 1962. Pp. 349. $7.

Is Kenneth Boulding's *Conflict and Defense* one of the great books of the twentieth century? I believe it is. It certainly provides the best existing analysis of the crisis into which nuclear weapons have plunged mankind. It also includes the germs of a method of analysis of all violence and conflict that may be of permanent major use to the sciences of man.

Conflict and Defense does not, however, fulfill the promise of its subtitle; it does not provide a general theory of conflict, in the sense of a logically coherent body of theory in which all the parts are dependent on each other. Instead, Boulding looks at the nature of conflict in general from a number of different angles provided by different theories, each theory developed from a single field in which conflict has been studied by a particular scholarly discipline. One of Boulding's major contributions is to make these specialized theories of particular forms of conflict relevant to other forms as well.

In the first half of his book, Boulding takes up each specialized theory and shows its generalizability. He examines, for example, the equations of Lewis Richardson in *The Statistics of Deadly Quarrels* concerning the growth of an arms race out of reciprocally reinforced hostility; the game theorists' models of the ultra-rational pursuit of self-interest; an economic analysis of business firm competition and viability; psychological theories of internal "avoidance-avoidance" conflict over the choice between unpleasant alternatives; and epidemiological models of the spread of illnesses, in which measles may conquer a population in somewhat the same way Marxism might.

In the process of generalizing these specialized theories, Boulding unites the "two cultures" in a way that will challenge both scientists and humanists—as might be expected from a theoretical economist who is also director of the Center for Research in Conflict Resolution at the University of Michigan. Drawing on mathematics on the one hand, Boulding presents the implications of the several theories of conflict by graphing the intersecting curves of opponents' hostility and power, to indicate where and under what conditions various kinds of conflict might achieve an equilibrium. (Such equilibria would be peace in its various forms—compromise, merger, annihilation, surrender, etc.) Simultaneously, Boulding parallels the graphs with discussions of the same processes in clear and witty English, and his examples and case studies are drawn from a wealth of insight into history, politics, and literature.

In the second half of his study, Boulding joins the parochial viewpoints into a way of looking at conflict in the round, from several viewpoints at once. For example, he shows how arms race theory, psychological theory, and business theory all have something to say about economic clashes or ideological rivalries. Although his analysis leads to important new suggestions about labor relations, business competition, and ideological confrontations, Boulding's immense achievement is in providing a new framework from which to view international relations. The foundation of this framework is his comparison of sovereign states to competing businesses.

A firm, Boulding explains, captures business over a territory according to its strength at home or headquarters, its distance from a competitor, and its cost for transporting goods toward its competitor's territory. Political systems try to extend power or control in a similar way. When the states are distant and the cost of delivering violence is high, the states are, in Boulding's terminology, unconditionally viable; that is, their boundaries may be liable to pushes and pulls but their independence cannot be destroyed. But when the cost of delivering violence drops (and the cost of defending against violence stays the same or drops more slowly), the state becomes vulnerable to extinction—that is, it loses its unconditional viability. If two opposing states are vulnerable to one another, the conflict is highly unstable: essentially, the system of defense has changed into the system of deterrence. What happens after that is, obviously, the key to the future of mankind.

In assessing the transition from defense through deterrence to the next stage, Boulding uses his conceptual framework to look back at human history. He outlines the succession of forms of states—for this purpose, emphasizing their size (as an indication of their home strength) and their technology (as an indication of their power to export violence cheaply). In this succession, Boulding shows, tribes fell before agricultural-feudal states (which sometimes temporarily coalesced into a universal agricultural empire); all these fell before industrial powers and even the industrial powers are now quailing before the superindustrial continental powers. What accomplished the victory in each case was a major jump in military technology; for example, the tribe of amateur warriors fell before the professional horsemen of Assyria and the feudal baronies fell before gunpowder and the industrial state. The changes have begun to come so quickly that we have witnessed the final conquest of the agricultural states of Asia and Africa in almost the same generation as the fall of the industrial powers before the nuclear superpowers.

Now it is becoming clear that even the superpowers are not unconditionally viable, and Boulding suggests that a world state is one possible result. Another is a collapse of technology that increases the cost of delivering violence so much that small states become viable again. This was what happened when the Roman empire collapsed and was replaced by a tribal system incapable of maintaining roads and legions. It could happen again if east and west engage in a war so disastrous that the centers of knowledge and wealth which support nuclear technology are destroyed.

One great value of this framework of Boulding's is that it indicates to other scholars the areas in which further research on conflict would be most fruitful. For example, the framework makes it possible to locate the points at which leaders of a state confronted with two unpalatable alternatives are most likely to break down or develop irrational and unpredictable new policies. Similarly, the framework makes it possible to examine the points at which ideological conflict, by overlapping with political conflict, can ease or exacerbate the situation, and to examine the roles of neutrality and diplomacy at various stages of an arms race and of mutual viability. Boulding's methods of analysis also suggest that the present crisis is not wholly unprecedented or incomparable, except in scale, and therefore that by research into comparable crises in interstate political conflict, the possibilities of resolution through conquest, reconciliation, compromise, or some other means can be estimated.

A second major value of the Boulding analysis is that it points to effective action in the world. He discusses the possibility of the separation of state and army and the merger of opposing armies as the prelude to their withering away. He discusses the implications of scientific "post-civilization," the third great period of human history, following upon the "civilized" period of agriculture as agriculture followed upon the era of hunting. And in many other ways (as when he implies that the fixation upon "Red or dead" may drive men to such irrationality as dropping an ass between two skunks would drive the ass), Boulding sketches out lines for unorthodox action and policy.

It is this joining of thought to action, of new research to new policy, that marks *Conflict and Defense* as a major work of social thought. In this sense—and this sense only—it echoes the combined analysis and call to action so characteristic of Marx. Both because the twentieth century crisis Boulding faces is even more extreme than the nineteenth century crisis Marx faced and because Boulding's analysis is far more subtle and far less dogmatic than Marx's, this book deserves the close and determined study by scholars and activists that Marx received.

Arthur I. Waskow

THE SONS OF ICARUS

Sir George Cayley, The Inventor of the Aeroplane. By J. LAURENCE PRITCHARD. New York: Horizon Press, Inc., 1962. Pp. 277. $6.50.

The definitive reevaluation of the contribution made by any one of the long line of the fathers of aviation demands more than diligence from the biographer. Diligence is essential, for the material available is usually patchy and not completely consistent. The skill and persistence of the private eye must be supplemented by the sternly logical selectivity and cynicism of the lawyer, by the understanding of the experienced scientist-technologist, and by measured affection for the biographer.

The memory of Sir George Cayley, Baronet, 1773–1857, has been unusually well served by an unusually appropriate biographer. Whoever was the father of aviation, Laurence Pritchard has a better claim than most to the proud title of foster mother of aerial navigation. A mathematician from Cambridge University, a lifelong student of aeronautical science and allied activities, a tireless historical and social researcher and writer, Pritchard was for a quarter of a century—the crucial quarter century of "aviation for all"—the Secretary of the Royal Aeronautical Society, and like all good secretaries he did far more than merely to advise and consent in the affairs of the society and its governing body. In this volume he does much towards filling the gap criticized by another author in 1933: "It is little less than a disgrace that up to the present moment no memorial whatsoever in commemoration toward the achievement of air navigation has been erected throughout his long life either in the country of his birth or in the country . . . he [Sir George Cayley] sought with high and disinterested purpose to serve."

By one of the happy coincidences which are seldom accidental, I had the privilege of receiving from the hands of the awesomely well-informed Dr. Lynn White, Jr., professor of history at the University of California at Los Angeles, a copy of his presidential address of 1960 to the Society for the History of Technology. Its title is "Eilmer of Malmesbury, an Eleventh-Century Aviator—A Case Study of Technical Innovation, Its Content and Tradition." This learned discourse on the prior art mentions the sad case of Icarus, victim of the thermal failure of an early adhesive plastic. After stringent examination, White awards the implicit title of first man to survive in glider flight to Abul Casim Abbas b. Firnas of Cordoba, for his flight of about 875 A.D. His biographer, the Moroccan historian al-Maqqari, says that Firnas "covered himself with feathers for the purpose, attached a couple of wings to his body and, getting on an eminence, flung himself down into the air, where, according to the testimony of several trustworthy writers who witnessed the performance, he flew a considerable distance, as if he had been a bird. But, in alighting again on the place whence he had started, his back was very much hurt for, not knowing that birds when they alight come down upon their tails, he forgot to provide himself with one. . . . He flew faster than the phoenix in his flight when he dressed his body in the feathers of a vulture."

Any British dissatisfaction with this award is dispelled by the second award, to the first man known to have made a glider flight over a course of substantial and measured length, and to have survived, albeit with two broken legs. This British triumph was achieved by Eilmer, a monk of the Benedictine order at Malmsbury in Wiltshire, England, at some time between 1000 and 1010 A.D. These limits are derived from the account given by the very dependable William of Malmesbury within the early years of the succeeding century. This includes references by Eilmer himself to a comet which he saw in his early days—probably that of 1006—which he associates with the comet which he saw in his later days, Halley's of April 1066. William records thus: "In his early youth he [Eilmer] had by some means, I scarcely know what, fastened winds to his hands and feet so that, mistaking fable for truth, [the first protest in aerial contests?] he might fly like Daedalus, and collecting the breeze on the summit of a tower, he flew for more than the distance of a furlong. But, agitated by the violence of the wind and the swirling of air, as well as the awareness of his rashness, he fell, broke his legs, and was lame ever after. He himself used to say that the cause of his failure was his forgetting to put a tail on the back part."

This first measured glider flight—for the evidence is strongly in favor of rigid wings of considerable area ("fastened . . . to his hands and feet") and made substantially rigid on the quasi-vertical axis but free to flap in the quasi-horizontal—covered a measured distance of more than six hundred feet.

Now we make a flight of nearly eight centuries duration from Eilmer of Malmsbury, Wiltshire, to Cayley of Brompton, Yorkshire, overflying meanwhile Roger Bacon with his paper project of "artificial wings made to beat the air," Francis Bacon's note that "many birds of good wing (as kites and the like) would bear up a great weight as they fly," Robert Hooke who "contrived and made many trials about the art of flying in the air," and his friend Bishop Wilkins' vision of flight "than which the is not any imaginable invention that could prove of greater benefit to the world or glory to the author," with our pilot Pritchard pointing out these paper staging points, including also the copious and ingenious paperwork of the great Leonardo da Vinci around 1500 A.D. Only with Cayley in the first half of the 1800's do we find the crucial point of take-off, as Cayley himself, with a refreshing directness says in 1817, "So far as the idea goes, we must take in a hundred from Daedalus to Bishop Wilkins, etc., but a rational and systematic theory of the principles in their general application has not yet appeared, and this I certainly lay claim to."

Cayley's first formal writing on the art is dated October 6, 1804, but it appears for the first time in print as "Appendix I" of Pritchard's book. Stimulated by the announcement of a fourteen-page pamphlet entitled "Bases of the Mechanism for Directing Air Balloons" by Professor Danzel, but without having read this work, Cayley started on this "Essay Upon the Mechanical Principles of Aerial Navigation" which remained unfinished. It contained, however, the valuable injunction that "the Bag or Balloon containing the gas ought to be in a form approaching that of a very oblong spheroid—but varied according to what may be found the true solid of least resistance in air, that this must be supported by a light longitudinal and two transverse axes of wood braced with cord to give stability to the fabric—to the hinder extremity of ye balloon must be fixed upon a universal joint a rudder of considerable length opposing both an horizontal and vertical surface (by the two plains of which it is composed) intersecting each other in right angles to the air. A handle to direct this rudder must communicate within the boat. The machine is now completed excepting the Power that is to communicate the motion. . . ."

Some exception! Cayley was to devote much thought—without substantial success—to the exception, which was to remain negatively dominant until the internal combustion engine emerged. Meanwhile, "to descend from pleasing dreams to my subject, I shall observe that I hope I may be justified in giving these ideas to the public unsupported by the actual accomplishment of the object of them—for it will be found that I make use of no new speculative means but of old and well-known principles familiar to the minds of Engineers and Navigators, the mode of application is the only thing novel and this is subject to strict Mathematical investigation."

This, with the application of simple but perceptive experiment guided by well-controlled speculation and carried forward by simple and sound mathematics, was the essence of Cayley's successes, which were considerable, save in the case of the hot air engine, where the basic obstacle of weight-to-power rates was heightened by a mass of lesser but equally intractable problems. His letter of September, 1807, to Nicholson's *Journal of Natural Philosophy* dealt with this subject.

Cayley's magnum opus was a letter to the same journal of September 6, 1809, resulting from a report in the preceding issue that a watchmaker at Vienna of the name of Degen had succeded in raising himself in the air by mechanical means. While showing the inferiority of man to bird in the distribution of muscular power he made his confession of faith: "I conceive in stating the fundamental principles of this art, together with a considerable number of facts and practical observations, that have arisen in the course of much attention to this subject, I may be expediting the attainment of an object that will in time be found of great importance to mankind, so much so that a new era in society will commence from the moment that aerial navigation is familiarly realized." The body of the letter is in full accord with the examples of Cayley's theoretical and experimental work described elsewhere in Pritchard's volume. He showed an unfailing instinct for the essence of each problem, a great talent for extracting simple but sufficient numerical data from uncomplicated experiment, and a sound judgment in the mathematics of basic aerodynamics.

On the seventeenth of April 1962, the London County Council unveiled, on a house in Hertford Street, Westminster, which had been Cayley's London residence between 1840 and 1948, a blue and white plaque declaring Sir George Cayley Bart to have been "the inventor of the aeroplane." His qualifications for this title include the making of a crude helicopter in 1796, the experimental glider of 1804, five feet in length, now accepted as the first proper aeroplane to fly, the full sized version of 1809, and the third edition of 1853, which carried Cayley's coachman over a considerable distance.

There should be somewhere on the blue plaque, the initials of J. Laurence Pritchard!

Sir Robert Watson-Watt

CIVIL DEFENSE AGAINST NUCLEAR ATTACK

A Selected Bibliography

In late 1961 a group of members of the Chicago chapter of the Federation of American Scientists made an effort to look through as much as possible of the recent literature on civil defense to determine what part of this literature would merit further consideration if a serious study of civil defense were to be undertaken. The following bibliography is a natural outcome of this project.

Much of the material looked at was confusing, misleading, or contained serious errors of fact, which will surprise no one who has tried to follow recent public discussions of civil defense. We hope we have weeded out this material. Much of the rest was based on other, more basic material available to us, and we have included some of this. We are certain that other basic material exists (engineering specifications for blast shelters, for example) which we have not seen. Also, it should be noted that very little in this list is concerned with defense against biological or chemical attack.

To a certain extent it is possible to separate the question of civil defense against nuclear attack into two parts. The first concerns the technical feasibility of shielding people against the effects of nuclear attack. The second concerns the political and other human factors which would determine how well a civil defense system would actually work if put to the test, and whether such a system would, in fact, be desirable from a long-range point of view. We have somewhat arbitrarily divided this bibliography into two such categories, the technical and the non-technical. They represent our choice of the most useful material that has come to our attention; suggestions for modifications of this list would be much appreciated.

I. Technical Aspects of Civil Defense Against Nuclear Attack

The first item is the most basic source of generally available information about the results of tests on the effects of nuclear explosions and on means of protection against these effects.

1. "The Effects of Nuclear Weapons. S. S. Glasstone, editor. Prepared by the Department of Defense. Published by the Atomic Energy Commission. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. $2.
2. "Performance Specifications for a Sound National Shelter Policy." W. E. Strope. U.S. Naval Radiological Defense Laboratory report, USNRDL-TR-132, 1957.
3. "Systems Analysis of Radiological Defense Systems." Kenneth D. Moll. Stanford Research Institute report, NP-7241, 1958.
4. "Specifications and Costs of a Standardized Series of Fallout Shelters." W. E. Strope, L. G. Porteous, A. L. Greig. U.S. Naval Radiological Defense Laboratory report, USNRDL-TR-366, 1959.
5. "AEC Group Shelter." AEC Facilities Division, Holmes & Nar-

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ver, Inc., Los Angeles, California, report. CEX-58.7. For sale by the Office of Technical Services, Department of Commerce, Washington 25, D.C. 50 cents.

6. "Close-in Fallout." W. W. Kellogg, R. R. Rapp, S. M. Greenfield. *Journal of Meteorology*, Vol. 14, p. 1, 1957.
7. "Fallout and the Winds." Civil Defense Technical Bulletin TB-11-21, October 1955.
8. "Probability of Fallout Debris Deposition." Civil Defense Technical Bulletin TB-11-31, June 1957.
9. "Protection From Fallout Radiation." Special Task Force Report to Gov. Nelson Rockefeller, State of New York, July 1955. Reprinted and distributed by the New York State Civil Defense Commission.
10. "Family Blast Shelters." Office of Civil Defense and Mobilization Interim Technical Bulletin (draft), May 15, 1959.
11. Hearings of the "Holifield committee," the Military Operations Subcommittee of the House Committee on Government Operations. In recent years this committee has held a number of very illuminating hearings on problems of modern weapons and warfare. The hearings contain the record of the public hearings; the reports of the committee summarize the hearings and present the conclusions and recommendations of the committee. Of particular interest are the hearings entitled "Civil Defense" held in August 1961.
12. "Local Fallout Radioactivity." Ralph Lapp. *Bulletin of the Atomic Scientists*, May 1959.
13. "The Family Fallout Shelter." Issued by the Office of Civil Defense. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. 10 cents.
14. "Fallout Protection: What to Know and Do About Nuclear Attack." Issued by the Department of Defense. Reflects present policy of the administration on civil defense with primary emphasis on protection against fallout only. Available free at post offices and civil defense offices. December 1961.
15. "A Proposed Civil Defense Program." Herman Kahn. Appendix IV of *On Thermonuclear War*. Princeton University Press, Princeton, N.J., 1961. $10.
16. "The Problem of Survival." Edward Teller. *Nuclear News*, November 1961.
17. "Nuclear Attack and Industrial Survival." *Nucleonics* (and other McGraw-Hill publications), January 1962. Reprints available for 20 cents each in quantities under 100 from Operation Survival, Post Office Box 573, Times Square Station, New York, N.Y.
18. "A Blast, Fire and Fallout Shelter." Ralph Lapp. Consumer Reports, January 1962.
19. "Effects of Megaton Blasts Estimated." *Nuclear News*, December 1961.
20. "A Study of Design and Cost Data for Family and Small-Group Fallout Shelters." A report by the staff of the Lawrence Radiation Laboratory, UCRL-6654, October 10, 1961.

The next two items illustrate the use an individual can make of basic material from the items listed above in trying to estimate shelter requirements in particular areas or under particular attack conditions.

21. "The Effects of Nuclear Weapons on Tucson." T. L. Martin, Jr. The University of Arizona Press, Tucson, Arizona, 1961.
22. "The Effects of Nuclear Weapons on Naperville, Ill." P. A. Moldauer. 1961. Copies available at 25 cents from P. A. Moldauer, D-208, Argonne National Laboratory, Argonne, Illinois.

II. Nontechnical Aspects of Civil Defense; the Desirability of a Civil Defense Program

The first four items below are concerned with the questions that must be considered in coming to a decision as to what civil defense program, if any, should be carried out.

1. "Civil Defense: Dangerous False Security or Indispensable Protection?" Speech by Rep. William Fitts Ryan in the U.S. House of Representatives, September 19, 1961.
2. "Statement by the Federation of American Scientists on Civil Defense Shelters." *FAS Newsletter*, December 1961.
3. "Civil Defense." Committee of Correspondence *Newsletter*, Box 536, Cooper Station, New York 3, N.Y., October 1961. This issue is devoted to arguments for and against civil defense by various contributors.
4. "To Build or not to Build?" Eugene Rabinowitch. *Bulletin of the Atomic Scientists*, November 1961.

The final items in this list take definite stands on the desirability of civil defense. They include part of the spectrum of positions that have been taken on the subject.

5. "Civil Defense: Shelters or Tombs?" Prepared by the staff of the Friends Committee on National Legislation, 245 Second Street, N.E., Washington 2, D.C. October 1961. 15 cents. (Against civil defense.)
6. *On Thermonuclear War*. Herman Kahn. Princeton University Press, Princeton, N.J., 1961. $10.00. (Favors a civil defense program.)
7. "Deterrence and Shelters." J. David Singer. *Bulletin of the Atomic Scientists*, October 1961.
8. "Community of Fear." Harrison Brown and James Real. Single copies free from Center for the Study of Democratic Institutions, Box 4068, Santa Barbara, California.

Chicago Chapter
Federation of American Scientists

SCIENCE AND ART

The Sciences and the Arts: A New Alliance. By H. G. Cassidy New York: Harper and Bros., 1962. Pp. 181. $4.75.

The Sciences and the Arts will be welcome to teachers and students as an expression of a contemporary enlightned view, but its value is limited by Mr. Cassidy's failure to make sufficiently clear discriminations and to provide guidance on urgent problems. He discusses many interesting special themes, but on basic issues there is sometimes a lack of precision. To take one example: he suggests that the sciences and the arts "converge at the levels of the laws and great principles which give us pictures of the world." This is misleading, although it conceals another idea, for the distinguishing aims of the visual arts and music have nothing to do with any laws or principles of science yet discovered. Certainly there is a common ground to all culture, but this has to be found at a deeper level, at its source in the human mind and in its historical origins.

The author is a Yale professor of chemistry. In designing science courses for non-science majors, he asked himself: Why science? How can science help to restore wholeness to life? So he explored the relations of the sciences and the arts, drawing widely on contemporary writing to help him meet the needs of students. This is an educator's scheme for a single culture in a time of hyperspecialization, supported by an interpretation of science and art and by valuable references to publications where various points have been treated more thoroughly. As such it will be useful, if read with discrimination.

But to restate an ideal in general terms helps little, unless it is applied to the specific problems that confront us. Can the rigor of exact science be conveyed to non-scientists? Since we possess no unified culture, how can this theoretical scheme for unity help the young to be better scientists, artists, or men in the technological world of tomorrow? Does a "union" of science, art, and philosophy lead, as is suggested, to valid ethical imperatives? If so, what are these imperatives, say as regards nuclear war or sex, and for whom are they valid?

Around 1890 Chekhov looked to a union of science and art as the one force which could redeem the world, as Goethe did a century earlier, and others before him. Why has the recurrent dream of a liberal ethic based on cultural enlightenment failed so disastrously in modern times? The difficulties facing all of us, including the teacher, require a closer look at history and at the present condition of the human psyche everywhere than Mr. Cassidy has here provided.

Lancelot Law Whyte

LETTERS TO THE EDITOR

FURTHER THOUGHTS ON SHELTERS

Freeman Dyson's "Thoughts on Bomb Shelters" (March *Bulletin*) was original and thought provoking. It did not claim to be anything like an exhaustive discussion of the merits of shelters, and neither is such a claim made here. I will attempt, however, to outline considerations which I believe tend to show that his opposition to a shelter program follows less directly from his arguments than his note appears to indicate.

The first remark, on the surface, appears to be a matter of details; it pertains to the calculation of delivery systems. It is my contention that the amount one can reasonably expect if war started today would be at most a shelterless Kahn. This conclusion can be reached easily using *New York Times* figures for the number of rockets and planes and their maximum megatonnage. I believe that the more makeshift delivery vehicles like ships and commercial planes referred to by Dyson are so inflexible and vulnerable as to add up to at most a factor of two over rockets and bombers. (For example, a boat carrying, say, 1000 megatons has a very high probability of being destroyed before its mission is completed by either conventional means or at the expenditure of a few kilotons.) While it is difficult to make predictions in this respect, I would suspect that it will take another two decades or so before a real beach stage is reached.

The reason why this seemingly minor remark is of significance is that weaponry as well as world politics develops fast and unpredictably. It is not at all unlikely that in two decades technical developments will alter our present discussion drastically or even make it irrelevant. One of the more predictable developments is the falloutless bomb. Less obvious are completely new generations of weapons. It is likely that in some cases not even the basic physics underlying these weapons have been discovered yet (remember the short six years between the discovery of fission and the bomb). It is however hard to disregard this possibility when one extrapolates twenty years ahead.

But let us assume, for the moment, that no such new developments will take place before we reach the beach stage. Does a shelter program advance the time the beach stage is reached and does it make the situation more severe? One of the important assumptions in Dyson's argument is that without shelters the opposing parties will exercise some kind of restraint by refraining from using their maximum capacity, while with shelters this restraint will not be present. This in turn presupposes both that such restraint is possible in a crucial situation and that civil population is a sufficiently important target to forgo such restraint for the sake of destroying it.

These are certainly open questions, and I can do little more than state my opinion that I do not believe such restraint is or will be exercised. My arguments would be based mainly on past history and on recent military developments, which of course are no sure guide to what will happen in the future. I also believe that civil populations are at most secondary targets, and hence Dyson's arguments should, for the sake of consistency, be directed first to other armament measures such as hardened silos which, if this argument holds water, contribute even more to the danger. I believe, therefore, that a shelter program will not substantially contribute to an advancing of the beach date.

While discussing the shelter problem, I would also like to advance another contention which is opposite to generally held views. It is often heard today that a shelter program would bring about a false sense of security and hence retard the cause of peace. I would like to suggest that this statement is not only incorrect but in fact the opposite is more likely to be true. Most Americans today have only the haziest notion of the effect of nuclear weapons and life in a post attack world. An inevitable adjunct of a vigorous civil defense program would be a widespread realization of the horrors of a nuclear war and hence a strengthening of opposition to it. It appears that the scant evidence available from countries with strong civil defense programs (such as Sweden and the USSR) would bear out this contention.

I believe that for the next two decades or so shelters will be important for a general stabilization of the world situation by reducing somewhat the benefits gained in a surprise attack. They will also reduce the casualties in an accidental war. Hence they should be built. Shelters, on the other hand, are clearly not the answer to the more basic problems of the arms race and are unlikely to be construed as being such. At the end of this twenty year period, there are at least three possibilities:

The millennium has arrived, all political and technical problems of disarmament and rearmament inspections have been solved and hence the beach problem is irrelevant.

The millennium has not arrived, and weaponry has undergone no qualitative changes. In this case the beach problem is relevant and the danger great. However, a shelter program is not likely to advance the date of reaching this stage or make it more severe.

The millennium has not arrived, but completely new weapons have been developed which eliminate the beach problem altogether and with it make the shelter question unimportant or irrelevant.

MICHAEL J. MORAVCSIK
Orinda, California

PSYCHOCHEMICALS

The attitudes, emotions and ideas expressed by Dr. Lieberman ("Psychochemicals as Weapons," January *Bulletin*) and by Dr. Leary, et al ("The Politics of the Nervous System," May *Bulletin*) resemble the two most commonly occurring reaction patterns elicited by "psychochemicals." Paranoid anxiety and hebephrenic optimism are the two characteristic outcomes of delusional states in healthy men of about 70 kilogram body weight after oral ingestion of approximately 500 mg, 100 mg and 8 mg of mescaline, LSD, and psilocybin respectively.

Jean Delay, the internationally esteemed French psychiatrist, offers (in chapter 13 of *Biological Psychiatry IV*, page 385, published by Plenum Press in 1962) a fitting general description of these delusional states. ". . . we can speak of regression as suggested by loss of the frames of reference for perception and memory, distortions in time and space, disturbances in body image and personality (ego), as well as disruption of the philosophical unity and direction of the individual. These processes lead to a disruption of the normal mental stream. There is, running parallel to this, loss of control, a liberation of the fantasy life, projection of the esthetic aspects of the subconscious, and a reorganization of the apparently anarchic quality of the thought processes according to the instinctual life rather than the demands of reality."

The resemblence between acute (experimental) drug induced psychoses in volunteers and the hallucinatory psychotic states seen in the wards of mental hospitals is so striking that, according to Delay, even a psychiatrist with considerable experience, if asked to examine blindly patients under the effect of LSD or psilocybin, may well consider the possibility that these are cases of early schizophrenia. Inappropriate affect and laughter, dysphoria, ecstatic states, and bizarre behavior as well as inexplicable changes in the relationship of the self to the world have also been noted in some of the experimental psychoses. Actually the symptoms of both paranoid schizophrenia and the drug induced delusional states respond very well to chemotherapy.

As one who is doing research in this area and 15 years ago coined the term "model psychoses" for the delusional states produced by certain psychotropic agents, I should like to comment on a few points raised in the two articles. First, Lieberman mentions that the water supply of an area could serve as a vehicle for the administration of imperceptible amounts of psychochemicals and goes on to say that chlorination does not alter the potency of LSD. This is not the case. LSD is very susceptible to destruction by chlorination as attested by Drs. A. Hoffman and A. Brack, the discoverers of LSD and psilocybin (in personal conversation with Dr. Brack at Sandoz Research Laboratories, Basel, in 1960).

Second, although it is true, as pointed out by Lieberman, that responses of different people to psychochemicals may vary from day to day and are unpredictable, it should be emphasized that there are typical reactors and non-reactors to these drugs under the approximate dosage scheme I mentioned earlier. To react or not to react of course raises another question not considered by Leary, et al., that is the problem of dosage. What happens to people who are exposed to higher doses of these drugs? The answer is that from a certain dosage level onwards everybody is a reactor. Dr. Leary and his colleagues are free to call these compounds "consciousness-expanding drugs" and to close their article with a utopian exhortation for general psychotherapeutic purposes. Dose-response relationships, however, continue to be a crucial factor which well could alter a consciousness-expanding drug into a consciousness-exploding one.

ROLAND FISCHER
Columbus, Ohio

Lieberman replies: My source for the statement that (ordinary) chlorination does not affect the potency of LSD is General William Creasy's testimony at the congressional hearings of June 16, 1959. Former Chief Chemical Officer, U.S. Army, he referred to "chemicals . . . in the general lysergic acid series well known to medical and chemical people. . . ." Roland Fischer is undoubtedly right; Creasy could be right, too, if he was referring to variants of LSD (not so well known) which are chlorine resistant. Whether or not chlorine affects LSD, the larger issues of "Psychochemicals as Weapons" still confront us. To meet the challenge we must expand our sociopolitical consciousness rationally and responsibly.

E. JAMES LIEBERMAN
Brookline, Massachusetts

DISARMAMENT

In a strangely unpublicized action, the U.N. General Assembly on November 24, 1961, by a two-thirds majority branded nuclear warfare a crime against humanity contrary to the U.N. Charter and called for an international conference embodying this principle in international law. Since then, our government has repeatedly reiterated its readiness to use nuclear weapons *first*—if necessary. Apart from the moral and legal issues posed by our commitments to the U.N. Charter and apart from the incredibility inherent in murder and suicide threats, this policy nevertheless continues our irrational dependence on nuclear weapons for defense purposes.

Suppose, however, our government accepts the U.N. judgment and renounces the first use of nuclear weapons—putting these weapons in the same category as germs and poison gas. Are we then dependent on an adversary's willingness to obey the law in a world where international law inhibits but does not guarantee compliance? Of course not! We can help enforce the law by transforming our nuclear establishment into an instrument designed to deter the use of nuclear weapons by others. We can, for example, announce a doctrine of equi-proportional deterrence under which we would retaliate against enemy caused nuclear explosions on free world territory by firing back the same number and similar size category of nuclear explosives against the same type of target. This would immediately diminish the chance of panic escalation to total destruction arising from mad bombers or stray missiles or probing enemy attacks to test our resolution.

But furthermore, nuclear weapons could even serve in unilatral initiatives toward partial nuclear disarmament. Suppose we announce that we will eliminate all but the hard, second-strike weapons (needed to deter surprise attack) from our arsenal within a definite time period. At its terminal point, we allow random sample inspections to prove our tactical denuclearization. Because we can now no longer retaliate in kind in all cases, we now shift to a doctrine of equi-numerical deterrence. Under this, we retaliate against a given number of tactical nuclear shots with a like number of strategic shots against strategic targets in the opponent's homeland. Since tactical mishaps would become highly unprofitable, the opponent might well be forced into tactical denuclearization for his own self-interest. To prevent ultimatum effects, negotiations would precede these steps, though, in any case, the opponent could not help notice that our object is extrication from the nuclear dilemma rather than jockeying for nuclear advantage.

Hopefully arrived at this point, nuclear suicide is nevertheless still possible. However, once nuclear force is restricted in the power equation to the mere checkmating of nuclear force, it should lose its attractiveness to the military mind. It is probably only then that total nuclear disarmament becomes realizable.

I submit the above ideas only in the hope they will stimulate the experts to explore further the implications of U.N. Resolution 1653 which has already outlawed the use of nuclear weapons before the tribune of world opinion—in spite of our opposing vote.

Ralph Anspach
Berkeley, California

I would like to make a suggestion for the disarmament negotiators. For the Russians, the oft-repeated objection to inspection is that it is allegedly tantamount to espionage and is thus anathema in a closed society such as theirs. Apparently a system of effective inspection that is distinctly different from espionage (or nearly so) is needed. According to experts, arms technology is developing at such a rapid rate that weapons systems become obsolete in as little as five years time. My suggestion is that we turn this situation to advantage through the use of inspection teams that are sent fully prepared to not return during the final quarantine period of at least five or ten years following completion of their task. Their work would consist of unlimited and uninhibited inspection, reported in a prearranged fashion that accomplishes the objectives. For example, an inspector can report via questionnaires that are designed to concentrate on compliance with arms control agreements and to avoid information that unduly endangers the security of the inspected nation.

Much negotiation is required before agreement can be reached on details of reporting, of course. There are problems in connection with activities during the quarantine period too. With respect to the latter, one can envision making use of the expert technical inspection personnel in cooperative scientific projects of nonsensitive types (communication and weather satellites, and Mohole excavations) during the quarantine period. But perhaps this concept of reciprocal espionage-proof inspection can contribute to the international dialogue on this vital subject.

George E. Hlavka
Los Angeles, California

KAPITZA

There must be many of us who will have enjoyed the article by Peter Kapitza, "The Future of Science," in the April Bulletin. I thought it very well done. His rating of the problem of controlled thermonuclear reaction ahead of the conquest of outer space in importance seems right to me. As a matter of taste, I would rate in interest another problem higher than either, i.e., that of reading and controlling the gene via the new molecular biology.

But it seems to me there was a glaring omission, especially from Kapitza. Superconductivity was discussed but he made no mention at all of the recent discovery of the high-field high-current superconductors, e.g., Nb_3Sn, NbZr, V_3Ga of Matthias et al. Quite apart from the providential appearance of this discovery for the realization of thermonuclear power, can it be doubted that this is destined to revolutionize the production storage and transmission of electrical energy?

James L. Tuck
Los Alamos, New Mexico

SCIENTIST, WRITER

I have just read the review of the Teller-Brown book, *The Legacy of Hiroshima* (reviewed by Hans J. Morgenthau in the June *Bulletin*). I am in sympathy with the reviewer's attitude and certainly by no stretch of the imagination in sympathy with Teller's attitude. In one respect, however, the reviewer goes too far.

He sneers at Teller for being a "scholar" and writing the book with someone who is "not a scholar." He says: "It is easy to understand why public figures who are too illiterate or ignorant to write a book themselves . . . would employ a ghost writer. But what does a scholar have to gain by doing this?"

The reviewer makes two very bad errors that display his own rather peculiar naïveté.

1) Who says that a scholar can

necessarily write a good book? Writing is a skilled art and many a scholar has not trained himself in that art. The ability to write forcefully and well is a creative talent not given to all. Many a non-scholar possesses it (Shakespeare was a non-scholar, if you please), and many a scholar lacks it. I cannot argue that Mr. Brown writes either well or ill for I have not read the book, though I will when I get a chance. On the other hand, if he writes ill, it is because he is Mr. Brown and not because he is "not a scholar."

2) The reviewer assumes that a scientist is automatically a scholar. This is, alas, far from true. Many a scientist is no more a scholar than many a plumber is. The mere fact that he is highly skilled at one particular specialty does not make him a scholar by any means. A plumber is skilled at one particular specialty, too. Consequently, a scientist may have very great need for a collaborator to place thoughts into adequate words. After all, one need only glance at any scientific journal to learn the sad truth that many scientists can't write their way out of a paper bag.

Isaac Asimov
West Newton, Massachusetts

A DEPARTMENT OF SCIENCE

George C. Sponsler's "Needed: Scientists on Top" (June *Bulletin*) is a welcome address to crucial issues of governmental reorganization posed by the snowballing scientific and technological revolution. His case for a cabinet secretary heading an executive department of science and technology is impressive.

It does not follow, however, that the secretary of such a department ought necessarily to be "a preeminent scientist or engineer with managerial competence." In this age civil control of science—granting the superficial fact that most scientists are civilians—poses problem potentials similar to those historically represented by the military officer corps as an elite guild vested with responsibility and power of such magnitude that distortive influences upon values and goals throughout the entire social fabric must be guarded against if a democratic polity is to be preserved. The scientist-statesman as secretary then may well be a useful choice on occasion, even as General Marshall was an appropriate exception as Secretary of Defense, but his selection by general rule is fraught with hazard.

Likewise the plea for transfer of the purse strings for research and development to the new secretary for science. Sponsler's dissent from Professor Oscar Morgenstern's thesis that the Bureau of the Budget actually rules research and development through ultimate power of approval of all funds fails to appreciate the necessity of comprehensive generalist review of requests from all agencies representing all purposes of the government in order to achieve a balanced presidential policy position.

The identification of science and technology as a major purpose requiring executive department status with cabinet and National Security Council representation is overdue. The grant of unprecedented fiscal autonomy and insistence upon guild membership of the proposed secretary are unnecessary and unwise. The reality of the hazard is demonstrated by Sponsler's judgment that "Scientists, engineers, and their laboratory facilities constitute a national resource of far greater importance than the natural resources which have traditionally been the concern of government." To whom and by what criteria? Are there not interdependent social values associated with both which require preservation of governmental arrangements which will assure mature mediation of equally sincere special interests in the greater public interest?

Wallace H. Best
Boston, Massachusetts

The article by George C. Sponsler, "Needed: Scientists on Top" in the June *Bulletin* is both timely and challenging. His contribution is the more valuable since government scientists so seldom speak their views as frankly. Of the articles in the *Bulletin* in recent years discussing science and public affairs, what percentage was written by scientists actually responsible for those public affairs—not just consultants on advisory committees or boards, let alone mere bystanders, but scientists filling full-time government line positions? I'd like to see more articles by government scientists.

Sponsler feels that the role of science and technology in public affairs is now so great as to justify a new executive department to control the government effort in this area. I do not disagree. It is necessary to point out, however, that competence cannot be legislated into an organization. A realignment of the government organization chart will merely shift existing bodies. Moreover, the establishment of a new department for science and technology will not lessen the need for scientists in existing departments—the Department of Defense, for example—an organization woefully short of line scientists already.

What I wish to do is focus attention on the tiresome but still critical basic problem: how to attract and retain competent scientists in government. There are many views concerning answers to this question: I contributed mine some time ago ("Mutual Obligations: Science and the Military," May 1958 *Bulletin*). I won't repeat them here, but I still believe in them.

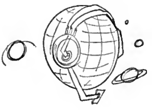
Burton I. Edelson
Washington, D.C.

ERRATUM

My article, "Vox *Populi*," which appeared in the June *Bulletin* contained a typographical omission in the second paragraph on the right column of page 33. The passage in question should read:

"A common pattern is discernible in all these examples. Public opinion is mobilized in a given direction to enable the government to pursue its policy of the moment. This is largely done by the sort of emotional appeal which is grist to the mill of the communications media, who continue to exploit it long after the original end has been achieved. Consequently the natural inertia of public opinion is reinforced, public attitudes become frozen, stultify national intelligence and force a continuation of the original policy even if it has ceased to make sense. As already pointed out this amounts to an overshoot whose correction depends almost entirely on natural feedback. In cases where this occurs rapidly this is not a dangerous situation. In foreign policy matters, however, the effects of a course of action may not make themselves fully felt or appreciated for many years so that the required correction may come much too late."

Robert Gomer
Chicago, Illinois



NEWS & REPORTS

THE FRENCH ATOMIC ENERGY PROGRAM

Bertrand Goldschmidt

The French atomic effort is characterized by a long series of government decisions and technical choices which have gradually brought France to its present position in the field of applications of uranium fission.

It has been made possible by the steady and sustained growth of the French atomic energy commission, Commissariat á l'Energie Atomique (CEA), which has benefitted from the constant support of successive governments, remaining unaffected by the fluctuating political fortunes of the Fourth French Republic and further consolidated by the Fifth.

French scientists played a considerable part in nuclear research before the war, particularly through the discovery in 1934 of artificial radioactivity by Frédéric and Irène Joliot-Curie, which was followed by their contributions in the neutron bombardment of uranium and the discovery of fission neutrons in March of 1939 by Joliot and his close associates, Hans Halban and Lew Kowarski.

• *THE WAR YEARS*

Given additional impetus by the war, initial French efforts received the support of the armaments Ministry in 1940. Work at that time was directed towards producing a chain reaction in natural uranium for the subsequent design of a submarine engine. The making of a bomb was considered too complicated and was not studied.

Heavy water had been chosen as moderator; this choice led in 1940 to France's purchase from Norway of the world's stock of heavy water—165 liters—a few weeks before the occupation of Norway.

The French effort, probably the most advanced in the world at that time, was prematurely halted by the invasion of Hitler's army. Halban and Kowarski fled to England in June of 1940 with the heavy water and in December of the same year, at Cambridge, conducted the first exponential experiment demonstrating the possibility of obtaining a divergent chain reaction in natural uranium.

The sequel to this work became the basis of the Anglo-Canadian effort launched by the end of 1942, first at Montreal and then, in 1945, at Chalk River. This program was directed toward building heavy water moderated reactors using natural uranium as fuel, a method still characteristic of today's Canadian effort.

• *INITIAL POSTWAR STEPS*

At the end of the war and following the nationalization of coal, gas, and electricity, General de Gaulle's provisional government decided to set up a national authority responsible for overall nuclear development; the CEA was founded in October, 1945. This organization profits from a degree of independence which is unique in France; although a public establishment, the CEA has financial and administrative autonomy. This decision was a wise one, for the experience of the last fifteen years has demonstrated that no country, however industrialized, can successfully attempt the development of atomic energy without a central state authority to direct and finance its development. To avoid the difficult choice between a scientist and an administrator as head of the new organization, the government decided to appoint both a general administrator, responsible for management and finance, and a high commissioner, in charge of scientific and technological development.

The first period of the development of the CEA, 1946–1952, was essentially scientific. The main task was the formation of teams of engineers and research scientists, and the creation of the basic laboratories which were to serve as a platform for launching of the CEA into its industrial stage.

The initial resources of the CEA were very limited, as the uranium reserves of the western world were at that time monopolized by the United States, England, and Canada, which decided to keep secret the know-how acquired during the war. Fortunately, ten tons of uranium oxide hidden in Morocco during the war were available, but this quantity was insufficient for the construction of a graphite-moderated pile and heavy water remained the only alternative. This was made possible by the following up the purchase rights of heavy water given in 1940 by its Norwegian producer. Four French physicists and chemists who had taken part in the Anglo-Canadian atomic war project placed at the disposal of their country their experience concerning heavy water reactors and the chemistry of uranium and plutonium. Then, in 1948, France's independent development of atomic energy was made possible by the discovery of large deposits of uranium in France.

At the end of 1948, the first atomic reactor in West Europe became critical at the Chatillon Research Establishment, located in an unused fort near Paris. This very low power facility used sintered uranium oxide as fuel, a substance which ten years later was to be recognized as one of the nuclear fuels of the future. In 1949, the first foundations of a large national nuclear research establishment were laid about twenty miles from Paris at Saclay, where the second French atomic reactor was started in 1952. This heavy water pile of 2,000 thermal kilowatts, fuelled with natural uranium metal, was the first reactor to be gas cooled, a method which is now used in both French and British atomic stations.

The rapid construction of the first

pile at Chatillon consolidated the scientific prestige of the CEA in the public mind. But the actual expansion of the organization was slowed down by the extreme left political attitude, hostile to the government, of Frédéric Joliot-Curie, its first High Commissioner, culminating in 1950 by his dismissal. It was not until nearly one year later that he was replaced by Francis Perrin, who is still responsible for the scientific management of the CEA today.

During these initial stages, the French atomic effort remained isolated from the main developments elsewhere in the world; this was in part due to the policy of secrecy of the English speaking powers and to the fear of other Atlantic nations that collaboration with France might prejudice the possibility of future cooperation with the atomic powers. Neutral countries were the first to enter into nuclear cooperation with France: India, with whom we signed our first agreement concerning the use of beryllium metal and beryllium oxide in atomic reactors in 1951; Sweden, in the heavy water reactor and metallurgy fields; and Israel, for the study of heavy water production and the processing of low grade ores.

• *INDUSTRIAL DEVELOPMENT*

The CEA was given its industrial impetus when Minister Felix Gaillard, responsible for atomic energy at the end of 1952, obtained from Parliament $100 million for a five-year atomic plan. The fabrication of plutonium with natural uranium reactors was the obvious direction to follow considering the previous work, uranium supplies available, and the somewhat limited financial resources. The production of uranium 235 was out of the question, since neither the quantity of uranium needed was available nor the funds allocated sufficient. It was therefore decided to build graphite moderated plutonium producing reactors at a new site at Marcoule, in the Rhône valley, with the plutonium to be subsequently used in secondary nuclear reactors for power or propulsion. The 1952 five-year plan made no mention of the possible use of plutonium in military applications, but it is certain that this eventuality was present—if not predominant—in the minds of those who suggested the five-year plan and encouraged its adoption.

It was decided in 1952 that the first reactor built at Marcoule would be air cooled at atmospheric pressure, similar to the one at Brookhaven. This was G_1, a reactor with a thermal power of 40,000 kilowatts, which has been in operation since 1956. The second reactor, G_2, cooled with carbon dioxide under pressure and producing 200,000 thermal kilowatts, was completed in 1958; it was decided in 1953 to add to this reactor an electricity recovery unit of about 30,000 electrical kilowatts. The building of a chemical reprocessing plant for plutonium extraction from irradiated uranium fuel rods was also included in the plan. The process applied is based on separation methods by organic solvent extraction developed in Canada during the war under the leadership of one of the participating French scientists.

The development of the five-year plan demanded the virtual mobilization of French industry, an undertaking carried out with success between 1952 and 1958 by the general administrator of the CEA, Pierre Guillaumat, later the minister responsible for atomic energy. Execution of the plan was accompanied by a considerable growth of the CEA: the total staff increased from 1,800 by the end of 1952 to 17,000 by 1961, while the yearly budget rose at an even steeper rate, reaching $450 million in 1962, three per cent of the national budget.

The 1952 five-year plan made it possible for France to become a producer of plutonium in military quantities within less than ten years. This could not fail to attract the attention of French government leaders at a time when England had just become the third member of the atomic club and both the United States and the Soviet Union were improving their first hydrogen bombs. The year 1954 saw the failure of the French Parliament to ratify the European Defense Community Treaty and the signing of the Paris Treaties, allowing Germany to start again on atomic energy for peaceful purposes only, while renouncing all military efforts in this field. It was then that Pierre Mèndes-France, Prime Minister, decided that his country should embark on the first steps leading to the construction of the atomic bomb and submarine. The fall of his government early in 1955 prevented a decision being made, but the following government did authorize construction of the submarine and of initial military nuclear research which was then kept secret. It also substantially increased the scope of the first five-year plan, in particular by adding a third reactor, G_3, identical to G_2 at Marcoule.

1955 was the year in which the veil of atomic secrecy was lifted at the first United Nations Atomic Energy Conference at Geneva. This conference had been preceded by two important events: the publication of the first British nuclear electricity program and the great success of the first U.S. atomic submarine. In the following year, the success of the first Calder Hall reactor proved the value of the natural uranium magnesium canned, graphite moderated, and gas cooled type of power reactor, which France was also engaged in building, although a couple of years behind Britain.

The French Electricity Authority then decided to undertake a power station construction program based on this same type of reactor, but on a less extensive scale than the British. It planned, following the experience gained at Marcoule, to successively build several reactors of improved design and increased power with the aim of an installed nuclear electricity capacity of 850,000 kilowatts in 1965. But in spite of the enthusiastic development of atomic energy between 1956 and 1958, the Suez crises, and the remarkably ambitious report of the "European wise men" (aiming at 15 million electrical kilowatts installed by 1967 in the Common Market countries), the briefly considered idea of doubling the French nuclear electrification program was not taken up. During the same years, the Saclay center grew to its full size with the divergence in 1957 of a materials testing facility of 15,000 thermal kilowatts and, in 1959, with the completion of a three billion electron volt proton-synchrotron.

In 1956, the government, headed by Guy Mollet, was very favorably disposed toward the Euratom Treaty then being negotiated; it considered setting up an organization for the six members of the proposed community similar to the one defined in the Baruch Plan, essentially peaceful in scope. The government gave up this proposal when it became obvious that the French Parliament would not accept this restriction to peaceful applications which would have implied an unilateral renunciation by France of her military nuclear potential. This change of policy led to the French parliamentary approval of the Euratom Treaty, which left all signatories (except Germany) free to develop nuclear military applications.

As early as 1955, during the negotiation of the Euratom Treaty, the lack of an uranium 235 production facility was recognized as one of the weaknesses of the Common Market countries in the nuclear field, and the creation of an European uranium isotopic separation plant was considered one of the principal tasks of the future community. The main proponents of the treaty first favored this project, then abandoned it under the pressure of those in favor of a Europe more closely tied to the United States, who were eager to avoid the political problems involved in producing a raw material capable of being used directly for the manufacture of atomic weapons. They considered it preferable to obtain from the United States the uranium 235 necessary for the development of European peaceful atomic energy programs, which could be bought much more cheaply than it could be produced by a relatively small European plant.

However, the creation of a French isotopic separation plant, a concept which had become symbolic of nuclear independence, was imposed by the French Parliament as an essential condition for France's ratification of the Euratom Treaty in June 1957; this ratification was accompanied by the allocation of about a billion dollars for a second five-year atomic plan for general nuclear development from 1957 to 1961.

France has also had to pursue independent development of natural uranium production. In 1957, the CEA considered purchasing important quantities of uranium concentrates from Canada instead of opening a new mine and its associated chemical plant. Negotiations failed, partly because Canada attached conditions of peaceful uses and safeguards to such a sale. The consequence of this failure was an expansion of national uranium extraction and an increase in overall world production. Indeed, French policy has never really favored the application of safeguards to natural uranium, for the abundance of this mineral throughout the world is such that a policy of safeguards encourages countries anxious to preserve their independence to produce their own uranium. This inevitably had led to an increase in general production, harming the interests of future worldwide nuclear disarmament.

Finally, in 1958, and in the absence of any real progress in nuclear disarmament negotiations, Fèlix Gaillard, then Prime Minister of one of the last governments of the Fourth Republic, decided to build and experiment with a plutonium bomb by 1960. The bomb thus became one of the final objectives of the five-year plan which this Prime Minister himself had provided for the CEA six years earlier. His decision was confirmed and strongly supported by General de Gaulle, who took over the reins of government a few months later.

• *THE MILITARY PROGRAM*

The only important help given this nuclear military program comes from the Franco-American Defense Agreement of 1959, which makes available 440 kilograms of highly concentrated uranium 235 to fuel a prototype submarine engine. The Congress of the United States has unfortunately refused France access to any secret information, despite a very clear American proposal of cooperation with NATO allies wishing to possess atomic-powered submarines. This offer was in fact made by President Eisenhower himself towards the end of 1957, at a NATO conference which took place in Paris shortly after the surprise of the Soviet Sputnik I.

Today, the American Congress still considers that France, unlike England, does not qualify for the exchange of information concerning nuclear weapons, although it would be perfectly possible for it to change its attitude now in view of the substantial progress made by this country with its first experimental nuclear explosions of 1960 and 1961. It is to be regretted that withholding information con-

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cerning weapons long since possessed by the Soviet rival, has forced France to undertake an unnecessarily drastic effort, particulary in the construction of an isotopic separation plant, building of an atomic submarine, and improving atomic weapons. This explains one of the main objectives of French dipomacy today, which is to obtain—like Great Britain—the status of a full nuclear ally of the United States.

Ten months after the first French atomic explosion in February 1960 of a plutonium bomb of more than 60 kilotons, Parliament passed a law for the development of an extensive five-year military program, which includes setting up an atomic deterrent force of nuclear weapons and their vehicles —supersonic aircraft or missiles—as well as the necessary financing for construction of an uranium isotope diffusion plant at Pierrelatte, in the Rhône valley. This last project, which will not be completed for a number of years, is a financial and technological undertaking on a nationwide scale, (nearly one billion dollars), much as the construction of a tunnel or bridge connecting France with England would be. Our laboratories and industries have been obliged to repeat all the work necessary towards improving the very same processes and techniques still kept secret by the three major atomic powers.

The CEA is thus responsible for the production of concentrated fissile fuel and the design and production of atomic weapons. However, the CEA, unlike the U.S. AEC, does not undertake weapons testing, which is carried out by the armed forces.

This extensive military program is bound to influence the CEA's activities since it is directly linked to about two-thirds of its present expenditures. As a result, top priority is given to the production of plutonium at Marcoule (about a third of a kilogram per day in normal operation) and to completing the isotope separation plant. An additional plutonium extraction plant is being built in the Cherbourg region, on the Channel coast. It will be used for reprocessing the French Electricity Authority reactors' fuel elements.

The history of the French atomic energy program will be concluded in the October Bulletin.

PROTEIN FROM THE SEA

The most important world food deficiency is in proteins, yet the sea could satisfy much of this deficiency. Even before beginning large-scale cultivation of sea flora and fauna, man could make more use of the natural fish supply. In the report of the Seventh Conference on Science and World Affairs in September, 1961, at Stowe, Vermont, two groups concerned with earth and biological sciences respectively suggested increasing the utilization of the world's oceans as a source of food. They emphasized the need for converting fishing from a hunting to an agricultural operation.

One process which has been developed in recent years and may provide immediate relief is the fabrication of whole fish meal or flour. This product could provide cheap protein for the almost two billion people now plagued with serious problems of malnutrition. It offers a partial answer to the ten-year-long search for low-cost proteins by organizations such as the United Nations Food and Agriculture Organization (FAO) and its Children's Emergency Fund (UNICEF).

The manufacturing process involves grinding up whole fish, followed by repeated washings in boiling solvent by which the product is defatted, deodorized, and dessicated. Azeotropic solvent extraction is the technical name for the process. Analysis shows the powder to be 83 per cent proteins with minerals, a trace of fat, and water making up the rest.

All proteins consist of the same ingredients—about 20 amino acids—and are assimilated into the human body after breakdown into these components. The nutritional value of protein of different origin is determined by the assortment of the amino acids present, and by their relative content. Fish protein produced by the above process was given a Mitchell biological value (amount of nitrogen used by the body as a percentage of the nitrogen absorbed) of 88 per cent, which is equivalent to that of milk protein and better than that of beef protein. The product's safety has been indicated by University of Illinois toxicological tests on four generations of rats. The fish meal did not deteriorate after 18 months storage at room temperature.

Because the concentrated protein-mineral powder is made from whole fish and contains parts not ordinarily considered fit for human diet—viscera, intestines, heads, tails—the Food and Drug Administration has refused to certify it. The FDA maintains that its composition makes the fish flour unaesthetic and that it will be repugnant to consumers, overlooking the fact that products such as gelatin are known to come from raw materials equally unaesthetic and that certain generally accepted fish products, such as sardines, contain bones and viscera while clams and shrimp are eaten whole except for their shells. That the fish flour is pure and clean chemically and biologically is not in question. The FDA itself says it is wholesome.

Most concerned over the adverse ruling are the two U.S. firms which produce the fish protein concentrate—the VioBin Corporation of Monticello, Illinois, and the New Bedford Fish Products Company of Massachusetts. Although these companies do not aim primarily at the domestic market, FDA approval is required by government agencies purchasing the product to send abroad. It is justifiably felt that the United States cannot send food to other countries if the food is regarded as unfit for home consumption.

The low cost of fish flour is one of its attractive qualities in considering its use in supplementing diets in poor countries. A pound can be profitably sold in large quantities for 15 to 20 cents, one-fourth to one-half the cost of milk, and one pound contains the proteins and minerals of six pounds of untreated fish. The Vio-Bin people say that for $250 million the animal protein deficiency throughout the world could be overcome in two years. Fish flour has a stiff competitor in skim milk powder, which is difficult to replace as a protein supplement because it is already widely accepted; however, it is priced higher.

Fish flour is cheap because the fish used are not edible ones and because they are not cleaned. To use only fillets would be prohibitive in cost, according to the Bureau of Commercial Fisheries. The fish used are abundant in all the coastal waters of the United States. It is estimated that the New England area could yield annually three billion pounds of fish not now used for any purpose. At this point politics enters the scene. Senator Saltonstall of Massachusetts along with Senator Douglas of Illinois is active in getting fish flour certified by the FDA. Perhaps each sees a great new industry arising in his state (it would be a boon for the depressed coastal areas of New England). The Bureau of Commercial Fisheries is also interested, for what it calls "the most promising advance in the fisheries field" could mean the up-grading of the fishing industry.

Although the two American plants are further along in the sophistication of the process, particularly as they make fish flour acceptable for human consumption, there is considerable production and experiment going on in other countries. Peru was expected to produce one million tons of fish meal for animal consumption in 1961. In South Africa there is a well-planned scheme for enriching bread with locally produced fish flour made chiefly from sardines. An experiment in Dakar incorporates fish meal into hard biscuits and pies made with millet and peanuts—a balanced product which has been well accepted. In Mexico, fish flour has been added to bread, all types of bean preparations, noodles, and tortillas without modifying the taste, odor, or texture of the foods. The Mexicans calculate that if a person consumes 30 to 40 grams of fish flour besides the usual bowl of beans and kilogram of tortillas, it is tantamount to a diet of four to five eggs, 750 to 1,100 cubic centimeters of milk, or 200 grams of meat.

While the controversy over certification of fish flour goes on enmeshed, as Science notes, in scientific judgment, aesthetics, and politics, the importance to poor lands of a cheap, stable, high-quality protein supplement can be summed up in the words of Dr. Federico Gomez of Mexico:

". . . after 10 to 20 years of supplementing the daily Mexican diet of corn, beans, and hot peppers with 30 to 40 grams of animal protein . . . the mass of people will have ambition, . . . will have more capacity for work, and will possess the satisfactions of healthy nutrition . . . this can be achieved by a method that does not change their traditional eating habits."

Helen C. Allison

REVENUE FOR THE U.N.

The Congo experience has dramatized the need of the United Nations for more ample and diversified revenues. It is especially important that the U.N. not be wholly dependent on current contributions by member states. Such contributions are subject not only to ordinary delinquency but also to deliberate withholding by disgruntled states. If the United Nations is to act effectively on behalf of the interests of the world community as a whole, it must have not only more funds but its own independent funds, from sources other than contributions of member states.

American history suggests the importance of this point. When our forefathers made the great transition of 1787 from the ineffective Articles of Confederation to the federal Constitution, one of the key innovations was the granting to Congress of power to lay and collect taxes. The Continental Congress had been dependent on contributions from Virginia, New York, etc., just as the United Nations depends today on contributions from its member states, with unsatisfactory results. The authority to raise revenue by taxing individuals and economic enterprises directly, not through the states, was a key element in the emergence of a federal power able to act on behalf of the general interest of the people of the United States even against the objections of some states.

How can direct revenue be found for the United Nations? Various suggestions have been advanced, most of them involving taxes on international transactions of one type or another—international trade, international canal traffic, international air traffic, a percentage of customs duties, and so on. While some of these suggestions deserve careful study, they all suffer from one or more defects. They propose to tax something which national governments or their subdivisions are already taxing; governments would be reluctant to cede their tax rights to the United Nations or to contemplate double taxation. They would necessitate a fairly extensive collection service of the U.N. on the territory of member states, which would be costly and duplicative and probably politically unacceptable, or alternatively the revenues would have to be collected by the member governments and turned over to the U.N., which would have some of the disadvantages of depending on state contributions. Or they propose types of taxation to which there are substantial objections on grounds of good economic policy, such as additional taxes on trade and commerce among nations.

Are there any means of raising independent revenue for the U.N. which do not run into these objections? I suggest that the clue which can guide us to some useful answers is the following: *Seek new sources of wealth which are being opened by advances in science and technology, preferably outside the jurisdiction of national states and not yet taxed by any national state.* The three most important such sources on the hori-

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zon today are space traffic and communication rights, ocean resources, and polar resources. It would be relatively painless for member states to authorize exclusive United Nations tax rights to such new sources of wealth in advance of their becoming practically important. This would not solve the U.N.'s immediate financial problems, to be sure, but as science and technology progress further these potential sources of wealth could become very important and within a decade or two the U.N. might have very substantial revenues from them.

Space traffic and communication rights: The use of orbiting satellites for relaying telephonic and TV signals, obviating expensive submarine cables or chains of micro-wave relay stations, is bound to have considerable monetary value. The U.N. should be given exclusive authority not only to license and regulate but also to tax this and other types of space traffic. A small percentage of the revenues from a worldwide communications network making use of space satellites might in a few years provide considerable income for the U.N. Quite aside from the revenue aspects, it is much more desirable to have satellite traffic regulated from the outset by the U.N. than to stumble into a confusion of conflicting national attempts to take jurisdiction over something that is in its nature supranational. The need for foresighted action on this topic is very urgent.

Ocean resources beyond the three-mile or twelve-mile limit: It will soon be feasible, using new technological advances, to drill for oil through the ocean bottom on the high seas. In fact, I have been told by a well-informed person that this is already possible and that at least one practical undertaking is presently going forward. The United Nations should have the same right to require a share in the product of oil wells on the high seas as Venezuela and Saudi Arabia have for wells drilled in their territories. Furthermore, it is known that mineralbearing nodules litter thousands of square miles of the ocean floor, and new developments in underwater equipment operated by remote control may soon make their recovery economically feasible. Harvesting of plankton or other potentially valuable constituents of the seas and farming of the oceans may some day be important industries. The United Nations should at once be granted exclusive authority to license, regulate, and tax all exploitation of ocean resources outside presently recognized limits of national jurisdiction.

Polar resources: Now that systematic exploration of polar regions is feasible, mineral resources may be found in the arctic or antarctic. Perhaps landing rights on transpolar routes, or even concessions for tourist hotels, may one day have revenue-yielding potential. In any case, the widest feasible agreement should be sought conveying to the U.N. jurisdiction over, and rights to regulate and tax economic exploitation of, all polar areas where national jurisdiction is presently unestablished or in dispute.

If these ideas are to be pursued seriously, there are a number of aspects on which detailed staff work should immediately be undertaken. The following are suggested:

An appraisal of the scientific and technological prospects for the kinds of developments in question, with an attempt to estimate how soon these developments might become practicable on a large enough scale to yield revenue.

An attempt to guess the order of magnitude of the volume of traffic and amounts of money involved in space satellite communications systems that might be envisaged within the next decade or two. No doubt the American Telephone and Telegraph Company, and perhaps other organizations, have already been making some types of forecasts in connection with their forward planning.

A study of the legal, institutional, and political problems to be confronted in achieving the proposed grant of regulatory and taxing power to the United Nations in such fields as space traffic and communication, ocean resources, and polar resources.

Eugene Staley

U.N. RESUMES SPACE COOPERATION EFFORTS

The forthcoming session of the United Nations Committee on the Peaceful Uses of Outer Space, scheduled for early September, marks a year of noteworthy increases in the rate and range of international discussions on cooperative space ventures.

After a two-year hiatus, international space cooperation took on renewed vigor in the fall of 1961. On September 25, 1961, in an address before the U.N. General Assembly, President Kennedy declared that the U.N. charter should be extended to the limits of man's exploration in the universe, that outer space should be reserved for peaceful purposes, and that weapons of mass destruction in space or on celestial bodies be prohibited. Kennedy indicated that U.S. proposals on these topics and others, such as communication satellites, weather prediction, and eventually weather control, would be forthcoming. One discordant note was sounded, however, in mid-November 1961 when the USSR, Poland, and Czechoslovakia, after first accepting the invitation of the National Aeronautics and Space Administration and the U.S. Weather Bureau, subsequently failed to attend the International Meteorological Satellite Workshop in Washington, D.C.

While this U.S.-sponsored activity was met with a rebuff, the Soviet bloc did attend the November 1961 meeting of the U.N. Committee on the Peaceful Uses of Outer Space, a fact noteworthy for its contrast with the Soviet boycott of all the previous sessions of this committee and its predecessor. On December 20, the U.N. political committee unanimously approved a sweeping resolution recommending that states consider that the U.N. charter applies to outer space and celestial bodies, that they are free for exploration and use by all states in conformity with international law and are not subject to national appropriation. Studies were called for to advance atmospheric science and technology and for effecting operational satellite communication. All states were called upon to furnish information on launchings to the public registry maintained by the Secretary-General. In conformity with this resolution, both the U.S. and the USSR submitted periodic reports on their launchings through April 1962 to the U.N. public registry.

Subsequent to the launching of the American satellite containing astronaut Glenn, an exchange of letters between Khrushchev and Kennedy took place calling for wider international space cooperation. Kennedy specified five areas for potential cooperation: weather forecasting, studies of the earth's magnetic field, space medicine, communications exchange and radio tracking stations, and joint efforts in manned and unmanned exploration of the moon and other celestial bodies. Khrushchev concurred in the desirability of cooperating in these areas and added four more: search and rescue of disabled spacecraft, study of legal space problems, an agreement to restrict experiments that interfere with peaceful explorations, and collaboration in observing launched objects and exchanging information. Complicating the advance of these positive and concrete recommendations was the inclusion by Khrushchev within the very same message of the admonition that cooperation would be greater if preceded by an agreement on general and complete disarmament, since the design and production of rockets had military as well as peaceful potential.

Encouraged by the momentum generated by the Kennedy-Khrushchev exchange and by the renewed use of the U.N. forum, the U.N. space committee met during the last week of March 1962 and discussed ways to promote space cooperation. While no formal resolution was passed, the committee did approve (without a vote) the report of its chairman which summarized the views expressed by the members during the session of the need for space cooperation, expressed satisfaction with the Kennedy-Khrushchev exchange, the desirability for coordinating the space activities of the U.N. specialized agencies and the governmental and nongovernmental organizations, and requested U Thant to prepare and keep current a survey of these organizational activities.

As a follow-up to the March session, the technical and legal subcommittees of the U.N. space committee convened in Geneva on May 28, 1962 to discuss specific methods of furthering cooperation. The legal subcommittee, without reaching agreement on any proposal, did adopt a brief report for submission to the parent committee. This report encompassed a set of legal space principles, a proposal postulated by the USSR on rescue of astronauts and spaceships, and proposals presented by the U.S. on assistance and safe return of space vehicles and personnel and liability for damage caused by space vehicles.

By unanimous approval, the technical subcommittee forwarded its report to the full committee. It included recommendations on an international sounding rocket launching base under U.N. sponsorship for establishment as soon as possible on the geomagnetic equator, and recommendations on exchanging information and encouraging international space programs. These reports will be considered at the session of the full U.N. Committee on the Peaceful Uses of Outer Space scheduled for early September.

During the space talks at Geneva, representatives of the USSR and the U.S. discussed the prospects of cooperation in meteorology, a world magnetic survey, and satellite communications, and forwarded recommendations to their governments.

While the establishment of the U.N. registry represents the only concrete cooperative space endeavor to date, there has been a noteworthy increase of international discussions. Probing operations and exchange of communications at several levels leading to proposals and recommendations are now emerging, all of which are necessary in striving for a common consensus.

Leonard E. Schwartz

MOSQUITOES IN ACCRA

The recent neutralist gathering in Accra, Ghana, called the Accra Assembly, was on the whole a more hopeful enterprise than one could have learned from press reports. To begin with, the slogan with which it was saddled—"The world without the bomb"—was misleading; the conference was not for nuclear disarmament alone but directed toward general and complete disarmament and rational planned investment in underdeveloped territories of the savings which would result.

About 120 people came to Accra for the last week in June, largely from Africa, Latin America, and the nonaligned countries of Asia. Russians and Americans were there both as participants and as experts who took part in the discussions, but were not called upon either to agree with or dissent from the conclusions of the participants. The principal American expert was James Wadsworth, formerly U.S. Ambassador to the United Nations and negotiator at disarmament talks and now Director of the Peace Research Institute in Washington. The principal Soviet expert was Professor Kozhevnikov, who was a judge at the Hague International Court during the period it was recognized by the Soviet Union. Other U.S. experts were Amrom Katz of Rand Corporation and William Higginbotham of Brookhaven National Laboratory. The original idea was that the experts should be no more than present and available to state the positions of their respective governments or give other facts. The neutrals would then, according to this idea, be free to propose any thing they pleased, regardless of what sort of faces the experts pulled. In practice, of course, it did not work out this way. The experts took a full part in the discussions on equal terms with the participants, and most of the participants felt that unless the experts from East and West thought an idea was worth at least putting forward for discussion, their governments would be unlikely to be much impressed by it. Idiosyncratic or hyperbold new solutions were thus avoided, and the final document was more staid than some people in their more enthusiastic moments would have wished to see.

The assembly by no means mirrored cold war attitudes. In order of importance, the interests expressed were: how to effect disarmament; how to insure that a lot of the money saved by it went to the poorest people in the world; whether colonialism and "new colonialism" (extraction of profits by foreign companies which are regarded as excessive) could be more easily terminated in a disarmed world; what specific actions the neutral countries could take to help develop this pattern and increase their weight in world affairs in general.

The assembly split into five commissions, and its final statement consists of the reports of these commissions combined. The first commission reported on the reduction of international tensions. Its basic principles advocated peaceful settlement and self-determination. The phrasing of the self-determination portions reflects the fact that most of the participants had the eradication of the remaining colonial regimes in mind, but they can be also interpreted to apply to the military domination by a great power of its weaker neighbors. The report endorsed various U.N. resolutions against the use, testing, and dissemination of nuclear weapons, and called on governments to stop war propaganda by "legislation wherever possible, and, in any event, by the strenuous exercise of influence and good example." The U.N. should take "an initiative in positive propaganda for peace." High altitude testing was condemned because it interferes with communications; this passage was drafted by Sir Robert Watson-Watt, of Canada. On China: "As there exists only one China, the Chinese People's Republic, its lawful rights in all the organs of the United Nations must be restored." This wording does not preclude the representation of Formosa.

The most substantial report was from the second commission on the disarmament process. First, it welcomes the agreement already reached at Geneva in the preamble and the working draft of part one of the treaty. Next, it explains that the deadlock on inspection and control arises from the U.S. fear that the Soviet Union might conceal armaments in excess of what has been declared, and the Soviet fear that the U.S. might, through inspection, gain enough target intelligence to carry out a first thermonuclear strike on the Soviet Union. The report suggests that these fears may be historically determined. But disarmament does not concern only the great powers; every nation in the world, from the greatest to the smallest, will have to take part in the process of inspecting and being inspected, and the report urges them to begin confronting the problems of local conflicts at once. These sections were drafted by Professor Viktor Knapp of the University of Prague and myself.

The report then calls—and this is the newest thing in the whole document—for the U.N. to convene a special conference which would draw up a regional disarmament and non-aggression treaty applying to Africa. This conference should consider the need for collective and individual guarantees by both Western and Eastern powers for setting up an African disarmament commission and for referring frontier and other disputes to the Hague Court. The Accra Assembly should itself set up a committee to go further into these possibilities, and get things moving. These proposals were drafted by J. H. Mensah, a young official on the economic planning staff of the Ghana government. President Nkrumah of Ghana also spoke to the assembly about his interest in such a plan.

The second commission's report goes on to urge that committees of qualified persons be set up in the U.N. to study the technical and practical difficulties of implementing those things regarding disarmament which are already agreed upon between East and West, and that this be done now. The U.N. should also begin at once to recruit and train inspectors. The proposals in this section, which was drafted by the former Irish Foreign Minister Sean MacBride, were designed to save time if and when agreement is finally reached.

Lastly, in a section drafted by Philip Noel-Baker of Great Britain, the report urges the admission of the press to the eighteen nation disarmament committee at Geneva.

The third commission, on the transformation of existing military nuclear material to peaceful uses, was under the chairmanship of Professor Ivan Supek of Zagreb, and included Professor Abdus Salam of London as a participant and Dr. P. Winkler of Czechoslovakia, who was the first Chairman of the Board of Governors of IAEA, as an expert. It urged a great strengthening of IAEA, which could serve to control the use of nuclear materials to insure that nuclear material released for peaceful use by disarmament would not be reapplied to military purposes, and that the plutonium produced even now by civil reactors in an increasing number of nations would be restricted to peaceful purposes.

The fourth commission, on economic problems involved in or arising from disarmament, followed fairly closely the recent U.N. report on the economic consequences of disarmament, declaring that nothing bad was likely to happen which foresight could not avert in all types of economy. It went beyond the U.N. report in saying that a very large and sudden increase of the flow of aid might do more harm than good to the receiving country; here too, advance planning was necessary. The report was largely drafted by Robert Nield, of the British National Institute of Economic and Social Research.

The fifth commission, on disarmament and the fundamental problems of hunger, disease, ignorance and servitude, was partly concerned with emphasizing the size of these problems but also called for efforts to insure that increased aid did not reintroduce colonialism, and for a study of the possibility of economic units at the receiving end which would "surpass national frontiers."

The assembly decided that future conferences should be convened by a continuing committee consisting of individuals from Morocco, Brazil, Afghanistan, Kenya, Ireland, India, Yugoslavia, Switzerland, Egypt, and Ghana, under the chairmanship of Mohammed el Fassi, the Rector of Rabat (Morocco) University. Someone from Spanish-speaking America will be added later. The next conference will probably be held once again in Accra, but the committee hopes they may then be held in different capitals year after year until the job is done.

Before the assembly convened, pessimists in the West saw two traps into which the enterprise might fall: it might become a sounding board for Eastern views (had not Nkrumah just been awarded a Lenin Peace Prize?) or it might be so amateurish as to be useless. In official circles in Britain, those experienced in the disarmament field were noticeably more gloomy than those experienced with Africa. No doubt Eastern pessimists saw a danger of its becoming a sounding board of Western views, although in fact the Soviet participants did not exert themselves as much as the Western and neutral ones but were content to try pulling other people's drafts as far as possible in their direction. My own tentative conclusion (as I write, the continuing committee has not yet had time to formulate its policy) is that the assembly has avoided these possible pitfalls and could be the beginning of a movement markedly more useful than any similar predecessor.

One of the two Ghanaian participants in the conference, Dr. Baffour, a geneticist and the vice-chancellor of the University of Kumasi, told the following fable. The elephant and the rhinoceros, having each decided the face of the other was too odd to be suffered any longer, began to stamp and trumpet so that all the little beasts ran away and took shelter. They turned to the two traditional peacemakers—the spider for his mildness and the monkey for his cunning—but both failed to quiet the superbeasts. At last, derided by the others, the mosquito undertook the enterprise. It flew straight into the ear of the elephant and then of the rhinoceros and there buzzed against their brains until it forced them to come to terms.

With good luck, careful handling, and imagination, the Accra Assembly and its successors could become a real means of helping the mosquito to find the eardrum.

Wayland Young

WOMEN IN GENEVA

"It has been my experience," said Tsarapkin, "that when women want something very much, they always get it." Asked to put this in writing for posterity, if any, he recorded it in Russian on the back of his place card.

The occasion was a luncheon given by Ambassador and Mrs. Zorin for five of the fifty American women who went to Geneva in April: Dagmar Wilson, the Washington housewife who started Women Strike for Peace last fall, Ruth Gage-Colby of the Women's International League for Peace and Freedom and a free lance writer at the U.N., Mrs. Martin Luther King, Jr. of Atlanta, Dr. Sadge Goldsmith of San Francisco, and myself.

The Americans and the fifty women from nine other countries who joined them by invitation in Geneva (including Olga Chetchetkena of the Soviet Union) got what they wanted: they made the negotiators pause—briefly, it is true—to listen to statements of the purpose of their negotiations—the human, moral purpose—before the long-playing recordings of national positions were turned on again. Each one of the seventeen automatic (and deaf) record players was silenced for a moment during the four day visit.

Arthur Dean endured this twice, and when he and Ambassador Zorin, shoulder to shoulder, faced 100 silent women from ten countries who neither applauded nor rose when the men entered Salle III of the Palais des Nations, their faces indicated that for that moment reality had set in.

The women were satisfied. The Americans had come because, as Dagmar Wilson said, "when women's normal work becomes meaningless in the face of annihilation, international affairs become their direct concern."

Seventeen states were represented by women whose vocations ranged from ballet dancer to country school teacher. All were mothers, some grandmothers. One had survived the Warsaw ghetto. One lived in Japan when Hiroshima and Nagasaki were bombed. By their presence and by the petitions with 50,000 signatures gathered in the United States in a week and a half, they had hoped to demonstrate the growing concern of women everywhere for the future of the race. They came prepared to ask for the one element which no expert provided: the will to agree. They hoped to arouse the dozing conscience of the world. They didn't pretend to be arms or tests experts, but they were knowledgeable; they had done their work.

How they went about their business was determined by a continuing consensus reached at a perpetual meeting from which teams of ten to fifteen departed to visit delegations and returned to report. No vote was ever taken; agreement was thrashed out; there was no disgruntled minority.

The skill required to direct this sort of democratic process was available in Eleanor Garst of Washington, D.C. She succeeded even in the eight other foreign languages which produced the joint declaration. Anne Marit Sletten Duve, the Norwegian scientist who read the declaration in English to Dean and Zorin said privately that she was fascinated "with this democracy, but I can only take a little of it at a time."

A Quaker, Mrs. Knopp of Westport, Connecticut, knew how to demonstrate the spirit in which the 100 women went to the Palais. She led a dead silent, unadorned, two by two, two-mile walk through a stunned Geneva to the gates of the Palais where the 100 stood, still silent, until permitted to enter. She politely refused repeated invitations by anxious minor officials to "take the tour" while waiting for the promised interview with assurances that the tour was not their purpose and they would be glad to wait anywhere until the gentlemen were free. The hour and a half wait in Salle III, the confrontation and the departure were accomplished in complete silence. One gentleman noted with awe that 100 women had been completely silent for three hours altogether.

Mrs. Max Gordon, wife of the prominent New York night club owner, knew how to make appointments. She will have to return to Geneva to see more of it than the inside of a phone both in the lobby of a second class hotel, but the Americans saw every delegation although they arrived without an appointment and spent only four days.

Mary Grooms, head of the Independent Political Forum of Rochester, New York, knew how to get down to brass tacks. Advised by Deans to ask the Russians why they mistrust the U.S., she did. Tsarapkin told her the United States has 33 bases around the Soviet Union. When she asked if dismantling some bases would help prove good faith, he replied, "Just one." After checking this independently with Olga Chetchetkena, Mrs. Grooms reported to Dean and asked him to give the women a base, "not an obsolete one," to turn into an exchange center. Dean stopped chuckling rather abruptly and said this was a request for President Kennedy. It is on the agenda for the interview the Geneva women have requested with the President.

Nearly every delegation visited said "Tell your President. He is the key." The women learned much of how the U.S. looks to other countries. Some of it was not pleasant to hear. For some of the women, a first trip abroad into the concentrated problems of world relationships was a difficult experience. To learn that Great Britain and Canada only "go along" as allies although they disagree often with our policies, came as a shock to those who read only American newspapers. They heard the neutrals, who welcomed them most warmly, and knew that theirs was the moral and human position.

Clarie Harvey, a beautiful young negro woman from Baton Rouge, knew how to state this at a mass meeting in England on the way home. She said, "as a member of a minority group in America, I was proud that the Nigerian delegation's resolution stressed the moral responsibility of the nuclear powers for the other people of the world."

Diana Collins, wife of Canon Collins of the Campaign for Nuclear Disarmament, left Geneva in time to arrange an afternoon reception for the Americans in the House of Commons and a large meeting in the evening. Twenty-four hours in London produced a tremendous response from the British peace workers—almost as though reinforcements had finally arrived after a long siege. "We didn't know there were any Americans like this" was the most frequent comment after speeches by a dozen of the women in both places.

For the Americans, the London experience italicized their new sense of personal involvement in a larger than national and older than America struggle. The House of Commons seemed the most appropriate place in the world to finish the Geneva march to the Palais des Nations where a silent confrontation of the representatives of the latest divine right—the right of sheer brute power—had made of strangers speaking eight languages a company with one voice, an advocate of today's common man's rights.

Perhaps the moral of the Geneva story is this: that the American woman who felt alone in her community had through the Women Strike for Peace found others in community, state, and country. In Geneva she found still others, the rest of the world, in fact. In England she found respect and gratitude. She flew home with a new horizon and an overpowering sense of dedication to the future. She found herself waiting silently before the White House, hoping to see her President. She made speeches, appeared on television and radio, wrote Congressmen, undertook to run for Congress, moved into American politics. She is a force to be reckoned with.

She hopes Tsarapkin is right about women.

Anne Eaton

AUTHORS

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Sir Robert Watson-Watt (review of Pritchard's *Sir George Cayley*, page 31), in addition to his scientific achievements in the development of radar, is the author of, most recently, *Man's Means to His End*.

Lancelet Law Whyte (review of Cassidy's *The Sciences and the Arts*, page 34), a scholar of the history of science, is the author of many books, including *The Atomic Problem* and *Essays on Atomism*.

Bertrand Goldschmidt ("The French Atomic Energy Program," page 39) is responsible for external relations and general planning for the French atomic energy commission. He is the French representative on the Board of Governors of the International Atomic Energy Agency and a member of the United Nations and IAEA Scientific Advisory Committees. He is the author of a recent book, *l'Aventure Atomique*, on the political and technical history of atomic energy.

Eugene Staley ("Revenue for the U.N.," page 43) is research director of the International Industrial Development Center of Stanford Research Institute.

Leonard E. Schwartz ("U.N. Resumes Space Cooperation Efforts," page 44) is a research associate at the Duke University World Rule of Law Center.

Wayland Young ("Mosquitoes in Accra," page 45), a British writer, participated in the conference at Accra, Ghana. He previously contributed "Report from Geneva" to the June 1961 *Bulletin*.

Anne Eaton ("Women in Geneva," page 47) of Cleveland, Ohio, was an American participant in the undertaking she describes.

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2 June, 1953. *Invoking the Fifth Amendment,* legal, practical and impractical considerations of its use, views by Bernard Meltzer and Harry Kalven Jr. This issue also includes Alexander Meiklejohn's *The Integrity of the Universities and How to Defend It.*

3 October, 1955. Leo Szilard's *Disarmament and the Problem of Peace,* an analysis of the Arms race with proposals on how to avoid the threat of war; other articles include: *The Peaceful Use of Atomic Energy,* by Homi J. Bhabha and *Sir Nuclear Fission,* by J. B. Priestley.

4 February, 1956. *Scientists and Politicians,* by Harry S. Hall a discussion of the difference in outlook between the scientist and other members of the community, plus speeches by Bertrand Russell, Lord Beveridge and A. V. Topchiev.

5 September, 1956. Issue devoted to a symposium (4 articles on *Science and Social Responsibility* with other articles) by J. Robert Oppenheimer, Victor Weisskopf and Ralph E. Lapp.

6 October, 1956. *Science and the World Economy,* a symposium of articles: with contributions by Lord Boyd Orr, Harrison Brown, Arthur Lewis, Alvin Weinberg and Robert Cook.

7 November, 1956. *Science and Government* with articles by Walter Elliot, British MP, and political scientist Herman Finer.

8 April, 1957. *Science and Philosophy,* a symposium of articles by Mortimer Adler, Philipp Frank and Michael Polanyi, *The Risks of Cancer Formation by Radiation,* by A. Lacassagne.

9 June, 1957. This issue includes an article by Max Born on *Man and the Atom* and two views on a nuclear test ban by Albert Schweitzer and Willard Libby.

10 September, 1957. *Do We Need a Foreign Policy in Science,* by W. Albert Noyes Jr. with articles by John Foster Dulles, Jerome H. Spingarm and Steven Dedijer.

11 March, 1959. *The Future of Man in the Atomic Age,* by the 1956 Nobel prize winner in chemistry is included in this issue along with other articles by Hubert H. Humphrey, Frederick Reines and John H. Manly.

12 June, 1960. *Biological and Chemical Warfare: An International Symposium.* 12 articles.

13 December, 1959. This issue carries an article by Julian Huxley titled: *The Future of Man* and *Scientific Method in Foreign Policy,* by Benjamin H. Williams.

14 March, 1960. Includes an article by Leo Szilard entitled *To Stop or Not to Stop,* and other articles and opinions by Adlai E. Stevenson, Hubert H. Humphrey and Frank Church.

15 April, 1960. George B. Kistiakowsky, former special assistant for Science and Technology to Dwight D. Eisenhower writes on *Science and Foreign Affairs* in this issue, also Gerard Piel, publisher of *Scientific American* on *The Economics of Disarmament.*

16 November, 1958. *Science and Education,* a symposium of articles by Bentley Glass, William Cornog, Dale Wolfle, Sir Eric James, Harold Taylor and others.

17 February, 1960. Contains the much quoted *How to Live with the Bomb—and Survive* article by Leo Szilard. In the same issue is an article by Harold Brown, *The Detection of Nuclear Explosions.*

18 June, 1954. This issue carries the Security Board Reports and other related material of the Oppenheimer Hearings.

19 November, 1957. *The Pugwash Conference; Soviet Reaction.* Additional articles by geochemist Harrison Brown, *"How Vulnerable are We?* and British Physicist P. M. S. Blackett, *Technology and World Advancement.*

20 April, 1955. A special issue on *Secrecy, Security and Loyalty.*

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